

# Design and Implementation of Smart Door Mat by using Vibrational Energy Harvesting Technique

Vinit B. Janbandhu<sup>1</sup> Sofia Pillai<sup>2</sup>

<sup>1</sup>P.G. Student <sup>2</sup>Assistant Professor

<sup>1,2</sup>Department of Computer Engineering

<sup>1,2</sup>L. J. Institute of Engineering and Technology, Ahmedabad, Gujarat, India

**Abstract**— The main object of this project is to generate energy from vibration that means from human and store that energy in battery and used that energy to drive electronic devices, up to 12 DC volts. There are non-conventional and conventional energy sources, conventional energy source are artificial like coal, gas, petrol etc. And these sources of electricity are limited and are available in particular region. But there are some unconventional source of energy like wind, sun etc these are easily available everywhere. Like that proposed system is also able to produce large amount of electricity using vibrations. Energy harvesting comes in many shapes and forms; in this project it generates power from human footsteps. Lot of human energy is wasted by walking, dancing, and gyming in everyday life. Proposed system helps in urgent situation condition which converts human wasted energy into useful electrical energy. This project has piezoelectric sensors in it which can convert vibration energy to electric energy with the help of that it will produce electricity by installing that device in stair case, parking slot, in military, dancing clubs and etc.

**Key words:** Energy harvesting, piezoelectric material, DC battery

## I. INTRODUCTION

Scientists are badly searching for renewable and green sources of energy to produce electrical power. In last several years, analysis has begun using piezoelectric material for structural vibrations suppression. Piezoelectricity is the electric charge that builds up in certain solid material in response to applied mechanical stress [4]. This strain can come from many different sources. Human movement, low-frequency seismic vibrations, and auditory sound are everyday examples. Except in few examples the piezoelectric effect operate in AC require time-varying input at mechanical resonance to be accomplished [1]. When a piezoceramic transducer is stressed mechanically by a force, its electrodes accept charges that tend to check the imposed sprain [2]. This charge may be composed, store and deliver to power electrical circuits. The piezoelectricity means electricity resulting from pressure. It is get that, which means to force or press, and electric or electron, which means tawny, a very old source of electric accuse [1].

There are conventional as well as non-conventional powers source, conventional energy source are artificial like gas, petrol etc. And these sources of electricity are restricted and are available in particular section. But there are some unconventional source of power like wind, sun etc these are easily available everywhere. Like that proposed system is also able to produce large amount of electricity using vibrations. Now days, everything is going to be electronic and every person is catch up with the advantages of electronics. The electronic products are booming up the life and also facts of the person. Proposed system is an

electronic device which has embedded in it. Like that proposed system is also able to produce large amount of electricity using vibrations. Proposed system will convert vibration energy into the electrical energy and store that energy into the battery and use that energy to drive multiple electronic devices. Energy harvesting comes in many shapes and form, and the growth. For example solar power has been key during the last decade. Proposed system has piezoelectric sensors in it which can convert vibration energy to electric energy with the help of that electricity produce by installing that device in stair case, parking slot, in military, dancing clubs and etc. lot of human energy is wasted by walking, dancing, gyming etc. in everyday life. Proposed system helps in urgent situation condition which converts human wasted energy into useful electrical energy. Renewable energy sources such as hydro power, solar power and wind power require high economic investments but give lower power output with respect to its cost [1]. Another source nuclear power plant gives a good source of power but the early setting up and maintains costs are higher than other renewable sources. In recent time, there has been rising interest in harness the power of mechanical vibrations and pressure to generate electricity.

## II. PREVIOUS WORK

In the most recent decades, piezoelectric materials complete vast development in incoming industrial gathering markets all over all branches, everywhere piezoelectric is old as the beginning resources intended for actuators as well as sensors. Particularly in shipping business, they set up frequent fields of applications.

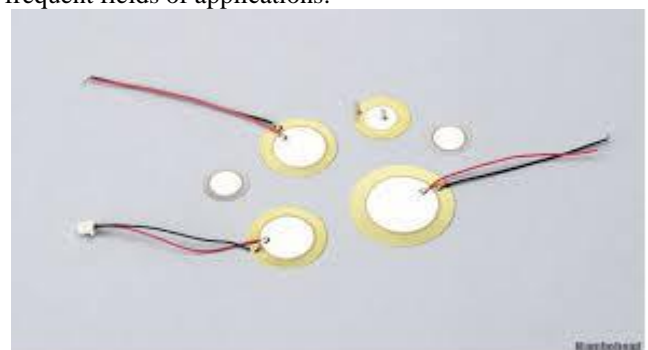


Fig. 1: Piezoelectric Sensors

The expansion of piezoelectric actuators used for petroleum booster systems is a accepted function of the by history, lively sound as well as vibration decrease is a present movement, and the employ of piezoelectric resources for power harvesting in vibrating structures is lone probable upcoming development [7].

Physical condition monitoring as well as harm recognition concepts contain concerned a lot of researches in the history, particularly among contribution of piezoelectric resources as the sensing fundamentals. Inside

the aforesaid plan In Mar, a fresh growth is in study. This is a carry recognition scheme for train wheels [1]. The plan is to identify the changes in the vibration actions of the whole wheel cause by the exterior changes on the continuing make contact with region, academic effort on the vibration actions of train wheels support to choose this kind of method [8].

In previously the electricity was made by few unconventional sources like wind, ocean wave, sound, solar from that concept has been taken and proposed concept is to convert energy from vibration. Here we are making a device that will convert vibrational energy into the electrical energy and store that energy into the battery and used that energy to drive multiple electronic devices.

### III. LITERATURE REVIEW

In 2014 Md. Mostaqim Billah Arnab, Shah Md. Rahmot Ullah, Md. Ashraf Alam, Raton Kumar Nondy proposed Generation of Electrical Energy Using Piezoelectric Material from Train Wheels 2014[1]. An approach has been completed to make productive application of the wasted sound energy. The proposed approach in this paper is to convert sound energy to electrical energy. The proposed translation route was tested in sound sources of train wheels and a judgment was made among other sources using this translation circuit and a better consequence from train wheels have observed. An effectual and capable new sound source has introduced which can be used as a suitable renewable power source. Here constant sound source from running train wheels is planned as a new renewable sound source. The act of the circuit for dissimilar frequencies of sound was tested and it was experiential that the circuit works fine for frequencies typically available from train wheels.

In 2013 Hidetoshi Tanaka, Goichi Ono, Tomohiro Nagano proposed Electric Power Generation Using Power-free Sensor Node 2013 [2]. Proposed approach in this paper is to convert Vibration energy to electric energy for power free sensor node. This paper describe a power-free sensor node operate by ambient power. The power maker consists of a piezoelectric resonator, with a power control circuit for recharge. Key technologies are the study model that compensates for inactivity moment of the piezoelectric resonator, with the power control circuit that stores scavenge current charge to supply immediate power for radio communication. An electric power producer is stand on a vibration-to-electric energy converter with a piezoelectric resonator. The power runs circuit that supplies electric power of the 180  $\mu$ W and stores electric power of 30 mW. As an effect, the power generator achieves 5 minute irregular operation of a power-free sensor node.

In 2013 Liqing Fang, Lei Zhang, Deqing Guo, Zilong Maiqing [3] proposed an Optimal Design of Monocrystal Piezoelectric Generator for Different Vibration Form 2013. Proposed approach in this paper is to convert wind energy to electrical energy. In this proposed approach, taking the wind piezoelectric generator as a model, consider useful application, the weights of associated factors which consist of area of piezoelectric covering, composition size and energy-generation capacity are calculated.

In 2011 Ahmadreza Tabesh, and Luc G. Fréchet, [6] proposed Modeling and simulation of the novel wave energy piezoelectric generator 2011. Proposed approach in

this paper is to convert ocean wave energy to electrical energy in this paper; a type of drag board point wave energy converter is intended. Reproduction result shows that the comparative displacement is generate between the float and the drag board. The set and trap is used to convert super-low-frequency linear motion into low-frequency rotating motion. Based on non-contact rate improved principle, a novel rotary piezoelectric generator is intended. Reproduction result shows that the reaction rate and the output power of this novel rotary piezoelectric generator can be improved with a non-contact permanent magnet arrangement. The results of this study show that the super-low-frequency wave energy can be harvested by the novel wave energy rotating piezoelectric generator proposed in this paper.

In 2013 Pratibha Arun, Divyesh Mehta proposed A Low-Power Stand-Alone Adaptive Circuit for Harvesting Energy from a Piezoelectric Micro power Generator 2010 [4]. Proposed system operates stand-alone, and it extracts the piezoelectric strain power self-regulating of the load and piezoelectric parameters with no using any outside sensor. The circuit consists of a voltage-doubler rectifier, a step-down switch converter, and an analog regulator operating by a single supply voltage in the range of 2.5–15 V. The controller uses the piezoelectric voltage as a reaction and regulates the rectified voltage to adaptively get better the extracted power. Elaborate criteria for comparing the act of energy-harvesting circuits. These criteria calculate an energy harvesting circuit allowing for wide aspects of effectiveness, adaptively, circuit difficulty, independence, and compatibility for micro scale execution. The proposed circuit is useful for well-organized energy conversion of vibrating piezoelectric generator by application to low power transportable/wireless devices. A well-organized piezoelectric energy harvester also increases the life span of the battery of a device or on the other hand can be used as a long-life power supply for self-powered remote sensor nodes.

While performing the literature survey it is observed that, these systems are mainly used in conventional and non-conventional power system which acts as source of power for various management systems. Here we are using a system which converts vibrational energy into the electrical energy

### IV. WORKING

Proposed system which is a like door mat which can install it in staircase, college entrance, parking slot, dancing clubs, flyovers [for vehicles and air plane] etc. after installing these devices when the vibration is created it will convert the vibrational energy into electrical energy via piezoelectric sensors. In figure it shown that there is a sensor based platform which has piezoelectric pressure sensor in it which is used to generate energy in electrical form. There will be a full wave bridge rectifier that converts the energy AC to DC. After that there will be a battery is use to store the transformed energy into the power storage. Proposed system has DAQ card for plotting the data coming from different sensors. It also analyzes the vibrational pressure coming from sensor and generates the power according to the pressure coming from sensors. Power in the proposed work is create from various vibrational sources like human

footsteps and running vehicles and after that use the power to drive multiple electronic devices.

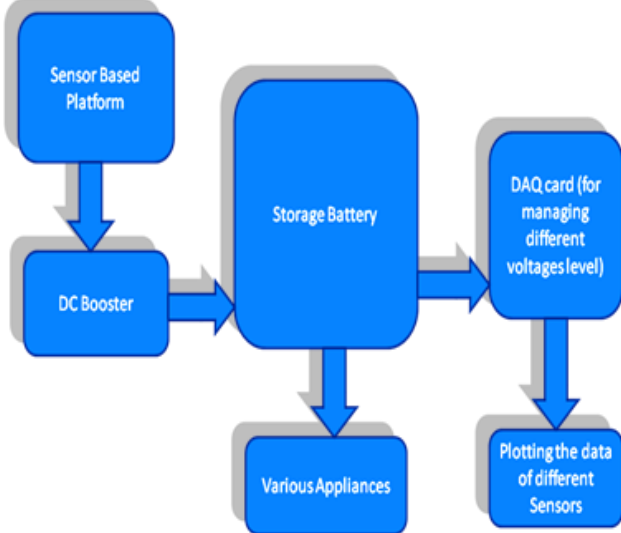


Fig. 2: Block diagram of System

## V. TECHNIQUE USED

### A. Explanation of Device as How It Works Is

#### 1) Implementation of Hardware

There will be a standing pad consist of array of piezoelectric sensors. This can be placed at the staircase or a crowded area. There will be storage appliance which will store the electric energy produce as of the human energy. The tool provides up to 12v DC provide. If we can connect dc booster it helps to generate high power dc supply.

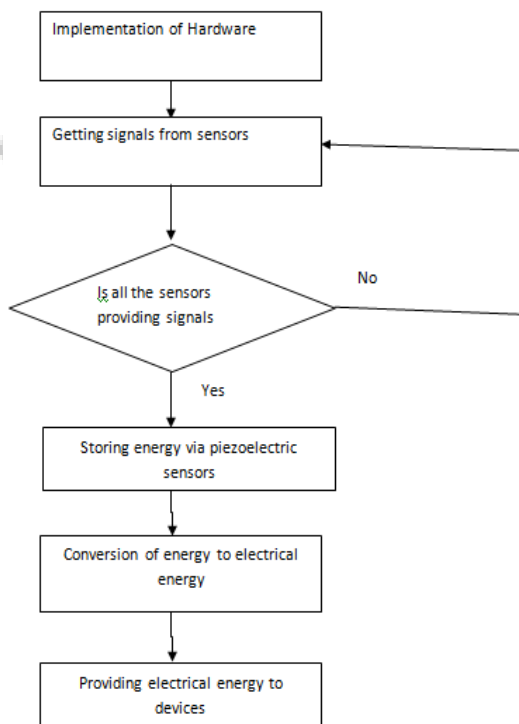


Fig. 3: Flowchart of system

#### B. Getting Signals From Sensors

When all the sensors are properly pressed it will convert the human energy or vehicles vibration to electric energy. We can generate power from not only on its own sensor of the system we can use multiple sensor to generate many

signal sources from the system. Multiple signals generate variation in power supply.

#### C. Tracing The Signals

If all the sensors are properly pressed then it will store the energy otherwise it will again check whether all the sensors are properly pressed or not. Because of using multiple sensors we cannot define which sensor on the system is properly working or not hence we used tracing the signal process to identify which sensor is working accurately.

#### D. Storing Energy

Storing the converted energy into the capacitor box which will provide up to 12V DC supply. Multiple sensors generate high power dc supply for which we modify the system by applying energy storage which store high energy. Conversion of energy: This will convert the ac to dc via analog to digital converter. This dc is then stored in battery and used to drive electronic devices.

#### E. Providing Energy

Generated energy is stored in battery with the help of stored energy we can drive the different electronic device. We are also using portable energy storage device which helps to generate sufficient amount of energy for emergency purpose.

## VI. RESULT

Results are taken with the software lab view. Lab view is software, it is mainly used to analyse the signals in waveform. In proposed system DAQ card is used to analyze the signals and plotting the data of different sensor that are connected parallel in door mat. DAQ card is a national instrument it is used for real time monitoring and sampling signals that calculate real world substantial condition and convert the sample results into digital numeric values that can be manipulate by a computer. Results are shown in the graph or in waveform format in lab view, whenever the pressure is applied on the sensors the different voltage readings are activate and shown for the different sensors. For proposed system there are multiple reading of voltage waveform has been taken which are shown below.

When all the sensors are properly press then it will show the voltage reading up to 12Volt.

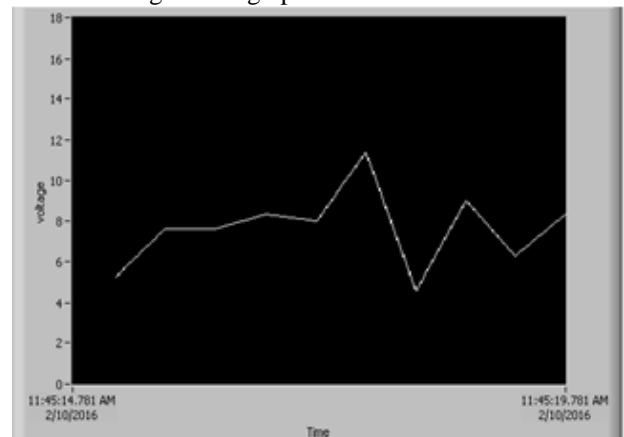


Fig. 4: Result of 12Volt

When no pressure is applied on the sensors then it will show null.

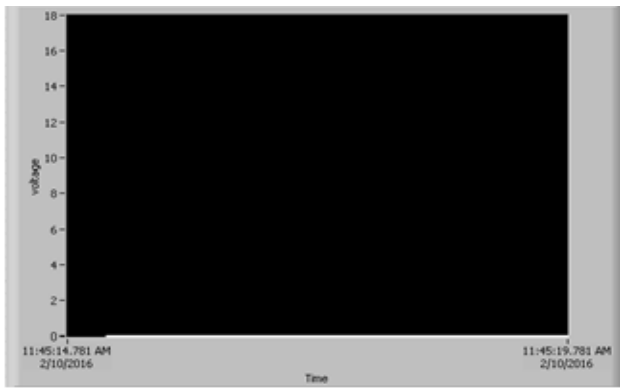


Fig. 5: Result of null

When there is constant pressure is applied on the sensor then it will show constant reading for that it is necessary to applied constant pressure.



Fig. 6: Result of Constant

Results are taken for single sensor also, when the pressure is applied on the single sensor only then it will also generate energy but not much voltage reading are in mille volts.



Fig. 7: Result for one Sensor

Results are also calculated with the mathematical expression. Voltage output for the sensors that are shown graphically are calculated mathematically. Mathematical expression is calculated by DC circuitry which is used in this project.

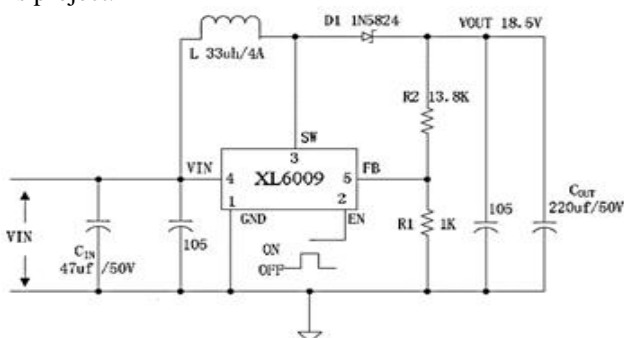


Fig. 8: DC Booster Circuit

If we want to know how much voltage is coming from one sensor it is required to calculate  $V_{out}$ .

So, the mathematical expression is,

$$V_{out} = R_2 I + R_1$$

Where R is resistance

$$= I (R_2 + R_1)$$

Where I is Current

$$= V_{ref} / R_1 (R_2 + R_1)$$

Where  $V_{ref}$  Voltage reference

$$V_{out} = V_{ref} / R_1 [R_2 + R_1]$$

$$V_{out} = V_{ref} [R_2 / R_1 + 1]$$

Here,  $R_1 = 1$  and  $R_2 = 13.8$  are given

With the help of above expression voltage output can be measure. Suppose for one sensor,

$$S_1 = 0.036$$

Put this value in  $V_{ref}$  we get  $V_{out}$

$$V_{out} = V_{ref} [R_2 / R_1 + 1]$$

$$V_{out} = 0.036 [13.8 / 1 + 1]$$

$$V_{out} = 0.4968 \text{ mV}$$

## VII. CONCLUSION

In this paper, an effective and efficient new vibrational source has introduced which can be used as a suitable renewable energy source. Here continuous vibration source from human or vehicle is proposed as a new renewable source. The proposed circuit is helpful for well-organized energy conversion of vibrate piezoelectric generators by function to low power transportable devices. This proposed system has piezoelectric sensors in it which can convert vibrational energy to electric energy with the help of that we can produce electricity. The act of the circuit for unusual frequencies of stress and vibration was experienced as well as it was observed that the circuit works well for frequencies generally accessible from different sort of pressure.

## ACKNOWLEDGMENT

I sincerely thank the HOD of Computer Science Engineering Department, Dr. L. G. Malik for their motivation, inspiration. I would like to thank Assistant Prof. Sofia Pillai for her kind support, guidance and encouragement.

## REFERENCES

- [1] Md. Mostaqim Billah Arnab, Shah Md. Rahmot Ullah, Md. Ashraful Alam, Raton Kumar Nondy, "Generation of Electrical Energy Using Piezoelectric Material from Train Wheels" IEEE 2014 Transaction on: The 9th International Forum on Strategic Technology.
- [2] Hidetoshi Tanaka, Goichi Ono, Tomohiro Nagano "Electric Power Generation Using Piezoelectric Resonator for Power-free Sensor Node " IEEE 2013: Central Research Laboratory, Hitachi, Ltd., Kokubunji, Tokyo,
- [3] Liqing Fang, Lei Zhang, Deqing Guo, Zilong Ma "Optimal Design of Monocrystal Piezoelectric Generator for Different Vibration Form" IEEE 2013: International Conference on Quality, Reliability, Risk, Maintenance, and Safety Engineering
- [4] Ahmadreza Tabesh, and Luc G. Fréchet, "A Low-Power Stand-Alone Adaptive Circuit for Harvesting Energy from a Piezoelectric Micro power Generator"

IEEE TRANSACTION ON ELECTRONIC, MARCH  
2011

- [5] Pratibha Arun, Divyesh Mehta, "Eco-friendly electricity generator using Scintillating piezo," International Journal of Engineering Research and Applications, Vol. 3, Issue 5, pp.478-482, Sep-Oct 2013.
- [6] Bingfeng Han, Jinkui Chu, Yesheng Xiong, Yao Fei "Modeling and simulation of the novel wave energy piezoelectric generator" 1. Key Laboratory for Dalian University of Technology Precision & Non-traditional Machining of Ministry of Education2. Key Laboratory for Micro/Nano Technology and System of Liaoning Province Dalian University of Technology, China
- [7] Jürgen Nuffer, Thilo Bein, "Application of piezoelectric materials in Transportation industry," Global Symposium on Innovative Solutions for The Advancement of the Transport Industry, San Sebastian, Spain, 4-6 October 2006.
- [8] E. P. Carden, P. Fanning, "Vibration Based Condition Monitoring: A Review," Structural Health Monitoring, vol.3, pp- 355-377.

