Emergency Smart Energy Harvesting System for Disaster Management

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ABSTRACT:

Irrespective of Android or china made Smartphone, main problem observed is battery limitation. While accessing internet services of mobile phone, fast battery drainage problem occurs. In rural or remote areas we cannot charge mobile battery time to time due to unavailability of continuous electric power supply. Not only mobile devices but also other low voltage operated devices requires emergency power supply for their operation. In disaster such as tsunami or earthquake, power supply station gets destroyed and needs emergency power supply. Hence in this paper we have proposed a portable handheld smart energy harvesting device as an alternate solution for the power stations. A proposed device generates current in three ways; by receiving energy from radio waves, by electromagnetic induction and from piezoelectric components.

Keywords: Piezoelectric, Electromagnetic, RF Energy, Green Energy.

[1] INTRODUCTION

All over the world, there are billions of people utilize mobile devices such as tablets, Smartphone's and laptops. The utilization of wearable gadgets expands this eco-system to high levels. The different tasks, for example, sending email, doing a phone call, finding location …etc. presented by these mobile devices which are battery-powered and regularly recharged, usually by connecting them to a power cord.

RF harvesting is very important source of energy because of level of transmitted and received signals and powers over the RF spectrum of frequencies has dramatically increased [1]. The power that is required to charge con-temporarily is mostly within microwatts or mill watts. This level of power can sometimes be generated using energy harvesters that can generate electricity using solar, mechanical vibration, temperature change, body temperature energy and electromagnetic induction. Energy harvesters are small systems which are able to generate electrical power using renewable sources of energy. There are many signals of different frequencies in the surrounding that can be recovered. Even though these signals carry a small amount of energy, utilization of air signals for energizing a low voltage circuit is investigated [2].

There are various methods to convert mechanical energy from vibrating or moving objects into electrical energy needed by electronic devices, including electromagnetic induction, electrostatic induction, and the piezoelectric effect. Compared with electromagnetic and electrostatic methods, energy harvesting with piezoelectric materials

provides higher energy density and higher flexibility of being integrated into a system, and thus has been the most widely studied. Piezoelectric materials possess crystalline structures in which the centers of positive and negative charges do not overlap, yielding dipole moments [1]. When subjected to mechanical vibrations or motion, mechanical strain is applied to these materials and leads to distortion of the dipoles, creating electrical charge. The electrical energy which is generated by harvester is get stored in rechargeable batteries or capacitors.

[2] EXISTING SYSTEMS

Energy harvesting sources:

There are number of systems that can be used for energy harvesting:

Wind energy generator:

In this technique large wind turbines can be used for energy generation. The disadvantages of this method are inconsistency of wind speed, requires large area for installment, due to its large structure cannot be a mobile system.

Solar cells: Solar cell converts sunlight and convert it into electrical energy. The disadvantages of this system are solar cells are expensive and has low level of efficiency, difficult to carry solar cell system and it is also depends on intensity of sunlight.

Power Bank:

Power bank stores the energy. It is a portable source of energy and also easy to carry but the only disadvantage of power bank is that it cannot generate the energy

[3] PROPOSED SYSTEM:

Energy harvesting sources: Here we proposed Radio Rod as a energy generation device with multiple ways. This will generates current in 3 ways:

Radio frequency energy harvesting systems:

This system utilizes RF energy present in the surrounding environment and converts it into electrical energy. As circuitry is small hence system becomes compact and easy to carry.

Piezo-electric energy harvesting:

In this system piezo-electric crystal is distorted due to vibrations and creates power. As structure is small hence overall system becomes compact.

Electromagnetic energy harvesting:

The movement of magnet inside coil generates electromagnetic and this energy is converted into electric energy.

Existing Work:

Earlier People were not much aware of the renewable sources and conservation of non-renewable sources but later energy harvesting methods were developed for the use of renewable sources. Then systems were developed to generate and store the energy so as to use it whenever it required. The People have searched for ways to store the energy from heat and vibrations for many decades. One, driving force behind the search for new energy harvesting devices is the desire to power sensors networks and mobile devices without batteries.

Hakan P. Partal Dept. of Electronics & Comm. Eng., Yildiz Tech. Univ., Istanbul, Turkey listed more method studied for RF energy harvesting as Design and implementation of a RF energy harvesting module with DC power control zero-bias RF energy rectifying antenna is designed at an ISM band, with the help of DC boost

converters DC output is amplified and stored in rechargeable batteries. The recent is analyzed for low power detection and rectification efficiencies, impedance matching network is implemented to reduce the reflected RF power at the rectifiers' input, DC to DC converters are evaluated for their compatibility to the rectifiers, and super-capacitor behaviours are investigated for their charging time and adaptability as wirelessly chargeable batteries. Many practical concerns and experiences are discussed for the RF energy harvesting systems' potential implementations on low power sensors and wireless communications network.

Yonas Tadesse, Shujun Zhang and Shujun Zhang and Materials Research Institute, Penn State, University Park, PA 16802, USA,CIMSS, Department of Mechanical Engineering, Virginia Tech, Blacksburg VA,s24061, USA. The device consists of piezoelectric crystals bonded to a cantilever beam Permanent magnet attached to the tip of cantilever beam which, oscillates within a stationary coil fixed to the top of the package. The permanent magnet serves two purpose (i) acts as a tip mass for the cantilever beam and lowers the resonance frequency, and (ii) acts as a core which oscillates between the inductive coils resulting in electric current generation through Faraday's effect. Thus, this design consist of the energy harvesting from two different mechanisms,namely piezoelectric and electromagnetic mechanism. In the fabricated prototype energy generated by electromagnetic mechanism was 0.25 Wand 0.25 mW using the piezoelectric mechanism at 35 g acceleration and 20 Hz frequency.

Flowchart:

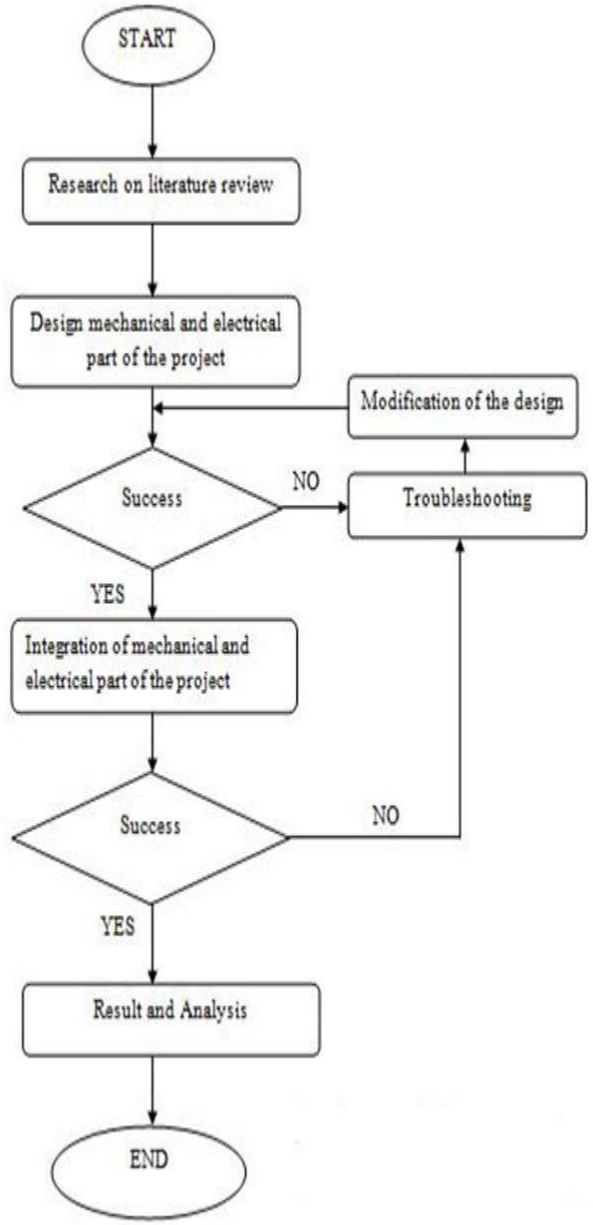

Fig.1: DESIGN FLOW OF SYSTEM

3.4 Block Diagram:

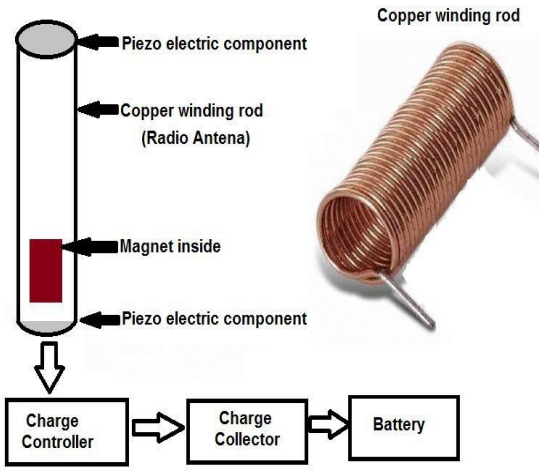

Fig.2: Block Diagram

This project is used to energy harvesting throw different methods and use as renewable sources. Here we proposed Radio Rod as a energy generation device with multiple ways. A radio rod will be a rod design using copper wire wounded circularly like a pipe. This will act as a radio wave receiver to receive energy from air. This rod is attached with piezo electric components at both sides and a magnet inside. This will generates current in three ways.

- By receiving energy from radio waves.
- By electromagnetic induction
- From piezoelectric components.

When rod is shake with a piece of magnet inserted inside, it will generate energy in the rod winding as per the Faradays low of electromagnetic induction. Also when magnet bounces on piezo electric components, piezo electricity will be generated. All the three generated energy will be given to the energy harvesting circuit, which will convert the energy into suitable form to store this energy.

[4] RESULT AND DISCUSSION

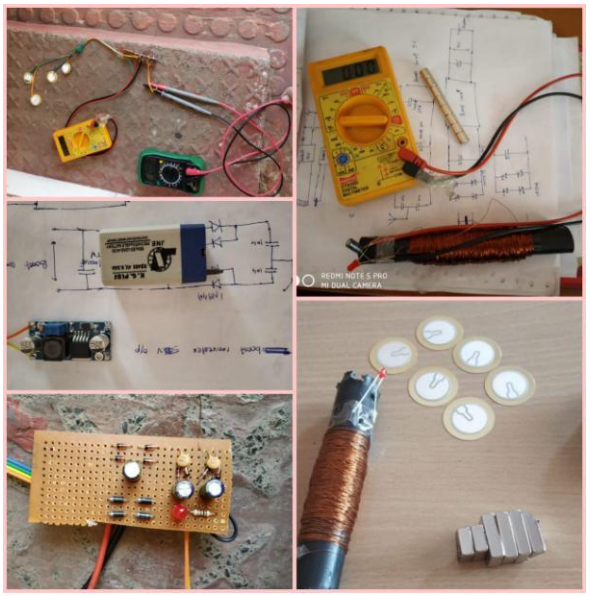

Fig.3: Actual Prototype

The rod system consists of electromagnetic mechanism along with piezo-electric mechanism. After electromagnetic and piezo-electric testing we got 2.4V output voltage. Voltage booster requires at least 0.9V as input and it boost into 5V, 1Amp as output. this energy can be

used directly to charge mobile or it is stored in rechargeable battery.

CONCLUSION

After reviewing through the whole system it can be observed that Smart energy harvesting system has many advantages like people will have portable and alternative power supply of green energy in case of disaster. This system will try to reach the society's present energy need and future energy demands. System provides an alternative to conventional energy sources and overcomes their disadvantages like pollution. The project totally based on "Waste to Power" concept and tries to add value in solving energy related real time problems.

REFERENCES

1. S. Saggini, F.Ongaro, L.Corradini, A. Affanni, "*Low-Power Energy Harvesting Solutions for Wiegand Transducers*" in Proc. 10th International Workshop on Piezoelectric Materials and Applications and 8th Energy Harvesting Workshop (IWPMA & EHW 2017), Hannover, Germany, July 16-17 2013, pp. 156-158

2. G. Giorgi, "*ISO/IEC/IEEE 21451 Compliant Sensor Nodes for Energy-Aware Wireless Sensor Networks*", IEEE Sensors Journal, Vol. 15, no. 5, pp. 2488-2496, May 2017

3 T. Salter, K. Choi, M. Peckerar, and G. etze, "*RF energy scavenging system tilising s itswihed capacitor DC-DC onverter*", Electronics Letters, vol. 45, no. , pp. 374-376, 2March 2009.

4 H. J. Visser and R. J. M. Vullers, "*RF energy harvesting and transport for wireless sensor network applications: principles and requirements*", Proceedings of the *IEEE*, vol. 101, no. 6, pp. 1410-1423, June 2013.

5. H. Nishimoto, Y. Kawahara, and T. Asami, "*Prototype implementation of ambient RF energy harvesting wireless sensor networks*", in Proceedings of IEEE Sensors, Kona, HI, November 2010.

6. X. Zhang, H. Jiang, L. Zhang, C. Zhang, Z. Wang, and X. Chen, "*An energy-efficient ASIC for wireless body sensor networks in medical applications*" ,IEEE Transactions on Biomedical Circuits and Systems, vol. 4, no. 1, pp. 11-18, Feb. 2010

7. http://www.wirelesspowerconsortium.com