International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-2, December 2019

An Efficient RF Energy Harvesting System for low power applications

M.Arun Kumar, J.R.Nishanth, R.Nivethika , R.Usha Nandhini

Abstract-: Next generations energy sources of Radio frequency [3MHz-300GHz] are the (QoS).The QoS is going to presents a on the progress of RF energy harvesting techniques. RF based wireless charging methodology are presenting the key to overcome the current issues in harvesting system Radio wave creates the radio frequency (RF) which is one of the sources of energy. The combination of electric and magnetic fields moving together in space forms the electromagnetic energy. The region in which these waves are found is called an electromagnetic field. In this modern electronic era radio waves can be used for many applications in according to the user requirements. Electromagnetic energy can travel through wireless medium so it can be used in a wide range of wireless applications.

Index Terms : RF energy harvesting, Quality of service (QoS), Wireless charging.

I. INTRODUCTION

Nowadays the RF energy scavenging techniques are becoming upsurge research interests. Harvesting energy [1]. The alternative techniques of energy harvesting are the 2 types that is inductive coupling and the magnetic resonance coupling. Power High in density and that of the conversion efficiency. Efficiency of power transmission depends on coupling coefficients, and the distance between that two of the coils or resonators. The limited power transfer distances are is cause the attenuation of power strength by the cube reciprocal of distance that is,60 dB/decade of this distance[3], [4].Transmitter and receiver requires the coupling calibrations and alignments of coils and this resonators for the inductive coupling and resonance coupling. Because of this reason, it cannot be applicable for mobile and remote replenishment/charging. The distance is 20 dB/decade and the comparisons in between three main wireless energy transfers technique had shown in the below table1. However, In this harvesting method, we mainly aims on the wireless networks which has RF energy harvest techniques. Operational designs in various types of RFEHNs. EM spectrum and from this range of RF spectrum we can create RF power

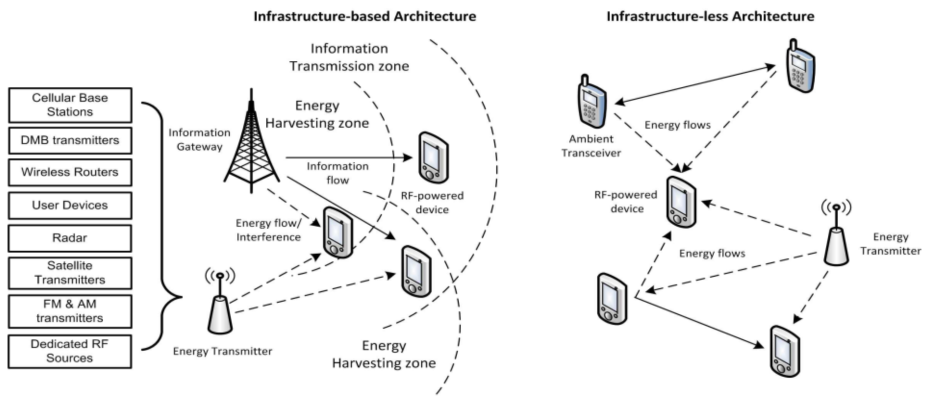

Fig.1. A general Infra structure based architecture of an RF energy harvesting network

Revised Manuscript Received on December 30, 2019.
***** Correspondence Author
M.Arun Kumar*, Assistant Professor, Dept. of ECE, Dhanalakshmi Srinivasan College of Engineering , Coimbatore, Tamil Nadu, India.
J.R.Nishanth, Assistant Professor, Dept. of ECE, Dhanalakshmi Srinivasan College of Engineering Coimbatore, Tamil Nadu, India.
R.Nivethika, Assistant Professor, Dept. of ECE, Arjun College of technology, Coimbatore, Tamil Nadu India.
R.Usha Nandhini, Assistant Professor, Dept. of ECE, Dhanalakshmi Srinivasan College of Engineering Coimbatore, Tamil Nadu, India.

International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-2, December 2019

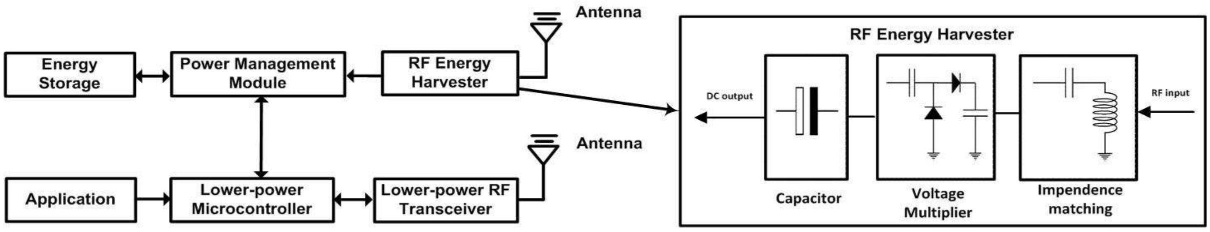

Fig.2. A general architecture of an RF energy harvesting device.

II. RF ENERGY HARVESTING NETWORK

Part, we will first introduces the architecture general of an RFEHN and this introduce Radio waves harvesting energy technique [24]. After that, we are starting for the analyses the existing applications of RFEHNs.

A. Harvesting RF Energy Network Architecture.

Network nodes block with the power RF capability harvesting is shown in above Figure 3 [29]. RF energy harvest module contains the following components [24] are:

- An energy harvester is composed by RF antenna, and the impedance matching, also with voltage multiplier and then a capacitor, which collects radio frequencies signal and then that converts it into the electric power,
- The management energy module, which store electricity obtained from RF harvester to use for information transmission, and
- An energy storage / battery

The incoming energy flow of energy can be controlled by two methods in power management module that are use harvest and store-use harvest [30]. The energy harvested is used immediately the node network in use harvest method [28]. Thus the converted electricity should constantly exceed the incoming energy flow of energy can be controlled by two methods in power management module that are use harvest and store- use harvest [32]. The energy harvested is used to power immediately the node network in harvest- use method. [26] Energy storing or rechargeable batteries that are attached to network node for the storage of converted electricity. At the condition in which excess of harvested energy in node occurs then that energy is stored back to future use.

B. RF Energy Harvest Techniques

The energy RF harvest methods have advantages over energy other harvesting sources such as, solar wind, and vibrations [33]. The major advantages are:

- Energy RF sources can produce a constant and energy controllable transfer over the required distance.
- For the fixed RFEHNs energy harvested is predictable highly and stable with varying time.
- The Energy RF depends on the distances between the radio sources.

Radio frequency sources are mainly classified in two types that are the dedicated radio frequency sources and the ambient radio frequency sources.

1) Also, energy harvesting process is fully controllable [34], and is more preferable for supporting the application which requires the QoS requirements [35].
2) RF Ambient sources: This source is refers to the transmitters [36] RF which are not applied for transfer energy RF. As well as energy RF is free source [38]. The power obtained from sources RF varies around 10^6 Watts for tower TV, 10 Watts for the cellular and also the RFID system, also roughly 0.1W in the case of mobile communication system and Wi-Fi devices [39].

III. CIRCUIT DESIGN

Also the main purpose is for the introducing of basic knowledge in the circuit design which is required for understanding the future aspects of the RF energy harvesting systems.

A. Circuitry Implementations

Huge number of energy RF implementations harvesting based on different technologies such as Complimentary MOS, the SMS and HSMS. A peak radio frequency to direct current efficiency of conversion with a power input.

B. Rectifier

The rectifiers are used for converting of the received radio input signals (form of AC) captured by antenna to an appropriate DC voltage. The main challenge of the rectifier design. Radiofrequencies to direct efficiency current of conversion. Silicon Schottky diode is used for retinas [40]. Normally, with less built in voltage of diodes achieves the higher rectifying efficiency. The reason behind this is their larger voltage that results more harmonic signals. Because of this reason the rectifier frequency should be decreased [15].

C. Receiver Architecture Design

- Separated Architecture Receiver: Alternatively called as antenna-switching [11], it consists of an independent antenna which has energy harvesting and data receiver to observe channels having different pattern. The separated receiver architecture is shown in the below Figure 4a. Harvesting of energy and data decoding operation are independently performed by the architectural design. The performance of separated receiver architecture can analysed by antenna switching scheme [11].
- Architecture Co-located Receiver: Thus the same channels can observe. Compared to receiver separated architecture the co-located receiver structure is smaller in size.

This architecture can of two models that are ime switching and power splitting architectures.

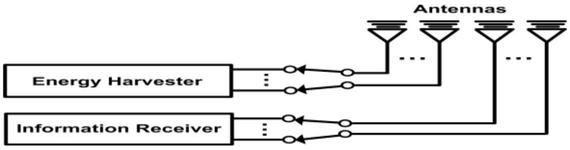

Fig.3 Separated Receiver Architecture

In the architecture of time-switching , when the signals of RF is received ,different time intervals occur, this architecture supports node to switch network in Fig 4b.

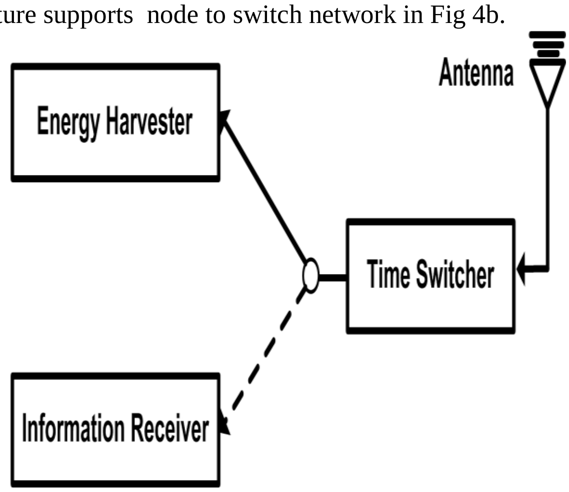

Fig. 4 Time Switching Architecture

Integrated Receiver Architecture:

The module of energy harvester is integrated in a rectifier for the Radio Frequency-to conversion baseband for decoding information which is proposed in integrated receiver architecture [17]. So, this architecture provide a form factor which is smaller. Also, the flow controller of Radio Frequency can adopt a power splitter or switcher similar to that of the architecture of receiver which is co-located . Figure 4d,will demonstrates for integrated architecture of receiver model. Also, the Radio Frequency for controller of flow can also choose a power splitter or switcher, similar to that of co-located for architecture of receiver.

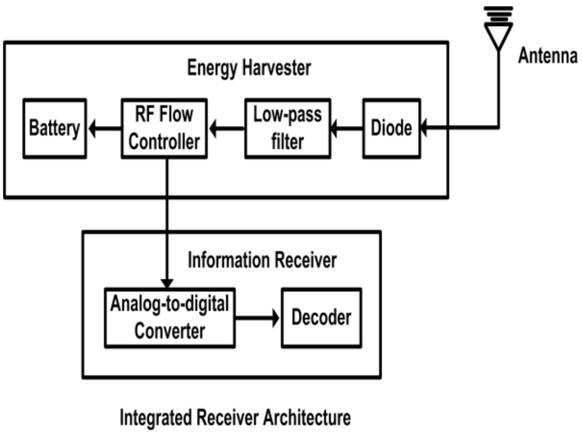

Fig. 5 Integrated Receiver Architecture

A. Practical Challenges

- Because of the square-inverse law that, density power of Frequency Radio waves proportionally decreases to the square inverse of practical Radio Frequency energy transfer, propagation distance, and the harvesting that complies to regulations of FCC which area then limited which is local. Moreover, as shown in [4], to discover rate of energy transfer 5.5W with power source with 4W, only the 15 meters distance of is possible.
- The gain and direction of the antenna receiver able to influence more on Radio Frequency of harvesting with energy rate thus that can effect than the transfer distance. Frequency which is wide range which is an on-going research issue for improving the energy harvesting efficiency.
- When the input reactance and resistance are not equal then the impedance mismatch occurs. Moreover that the antennas whose harvested power to the rectifier are not possible to deliver. Due of this reason, the efficiency of energy conversion is degraded by the variations in impedance (e.g., on-body antennas introduced using this) severely. Thus it is needed to minimize impedance mismatch by automatic tuning in the circuit design itself.
- The Radio Frequency converted to Direct Current with efficiency conversion depends on density of the harvested Radio Frequency power. Low harvested input power is important for improving the Radio Frequency to Direct Current conversion efficiency. Also, a Radio Frequency which is highly efficient energy harvester can be achieved by realizing a low power with highly efficient Direct Current to Direct Current converter that is used to convert a source of the Direct Current from one voltage level to another.
- Size of the Radio Frequency harvesting energy components should be small to low power embedded devices [40] i.e., Radio Frequency powered component size should be minimum than the other components. As introduced above, the major components needed in Radio Frequency harvesting energy are independent antenna, rectifier and a matching network. The energy harvesting rate depends on the antenna size. Also, impedance loads with high value (e.g., 5M), can only produce a high voltage output at the rectifier. It is a impedance function. This factor is a challenge to decrease the dimension of the devices which is embedded during maintaining efficiently high energy harvesting.
- The information sensitivity receiver's that of the Radio Frequency energy harvester is higher. Thus, when the receiver is located far away can only decode. Thus the Radio Frequency energy harvesting circuit's sensitivity should be improved.
- For Radio Frequency powered devices, multiple antennas should be used for improving the efficiency transmission and transmission efficiency. The method to reduce this trade-off needs to be improved. In an environment which is dynamic which is above issue becomes complicated, e.g., with energy harvesting rate varying.
- Also, high computation algorithms are not practical because Radio Frequency powered devices are having a strict power constraint operation. The schemes adopted should be efficient in energy and have low power and the schemes include modulation and the coding,

the routing protocol and receiver operation policy Since, because of this the power consumption is considered as a serious issue in Radio Frequency powered devices.

- Thus, for the conventional networks the design require to be further designed.

IV RESULTS AND DISCUSSION

The strength of RF signal received get boosted by buck converter and the appropriate pulse is generated by the PWM

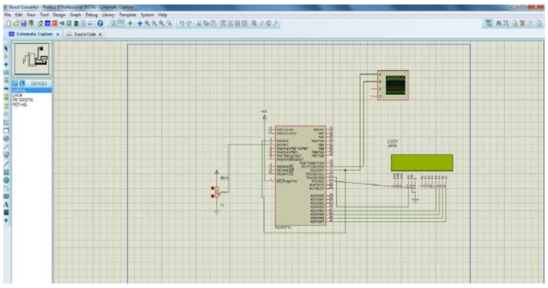

Fig. 6 Simulation Results using Proteus Tool

Whenever the radiation is detected then the LED glows. Thus, in the figure 7, we can notice that the LED is glowing and the input voltage gets boosted in to 12 volts from 2.7 volts. Also, when a mobile is kept near the capacitor diode parallel network during the calling time the radiation gets generated and the system acquires the RF signal and voltage gets boosted.

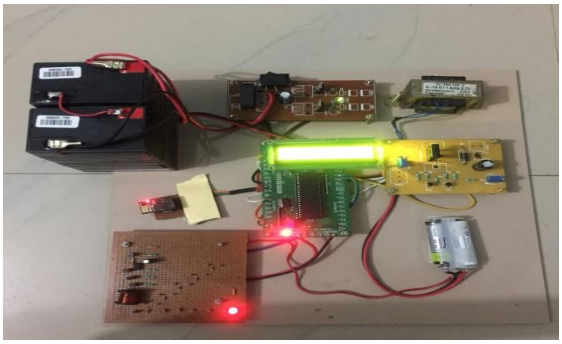

Figure 7 :RF Power Harvesting Module

The RF radiation in any place mainly near to tower (almost at a 1km distance) the battery can be charged by the RF power harvesting module.

IV. CONCLUSION

Networks using harvesting of Radio Frequency energy are used in harvesting systems. We have provided an Radio Frequency-EHNs by focusing on the architecture, applications and enabling techniques and it is mainly used for harvesting system. The Rf energy harvesting system is mainly used for low power applications. In future we can implement the RF power harvester module to provide free charging in IOT equipment's such as in home applications, industrial applications, to charge the sensors in remote areas for the analysis of power consumption in those areas, also we can charge bulbs, and other low voltage required components to save electricity.

REFERENCES

1. J.P. Curty, M. Declercq, C. Dehollain, and N. Joehl, Design and optimization of passive UHF RFID systems, 1st edn., Springer ScienceBusiness Media, New York, 2007.
2. J. A. G. Akkermans, M. C. Van Beurden, G. J. N. Doodeman, and H. J. Visser, "Analytical models for low-power rectenna design," IEEEAntennas and Wireless Propagation Letters, vol. 4, pp. 187-190, June 2005.
3. X. Zhou, R. Zhang, and C. K. Ho, "Wireless information and power transfer: architecture design and rate-energy tradeoff," IEEE Transactions on Communications, vol. 61, no. 11, pp. 4757-4767, November,2013.
4. E.Ramakalaivani, E.Rameshmarivendhan, N.Suma "Prediction of Diabetes with hybrid prediction model using Big data in health care," International journal of Engineering and Technology, Page No: 21-23, Vol 7 Issues 1 2018.
5. Malik Sikandar Hayat Khiyal, Aihab Khan, and Erum Shehzadi Software Engineering Dept., Fatima Jinnah Women University, Rawalpindi, Pakistan ,"SMS Based Wireless Home Appliance Control System (HACS) for Automating Appliances and Security," Issues in Informing Science and Information Technology, Volume 6, 2009.
6. Ramesh Marivendan. E, P. Rajasekar, Swathi K.S, "Lo detector with less timing misalignment and improved signal quality," International Journal of Current Trends in Engineering & Research (IJCTER), Page No: 96-102 2017/5.
7. P.Rajasekar and Dr.H.Mangalam, Efficient FPGA implementation of AES 128 bit for IEEE 802.16e mobile WiMax standards," Circuits and System,2016,volume 7, Page 371-380.
8. P.Rajasekar and Dr.H.Mangalam, "Design of Low Power Optimized MixColumn/Inverse MixColumn Architecture for AES," International Journal of Applied Engineering Research ISSN 0973-4562 Volume 11, Number 2 (2016) pp 922-926.
9. P.Rajasekar and Dr.H.Mangalam,"Design and Implementation of Low Power Multistage AES S Box," International Journal of Applied Engineering Research ISSN 0973-4562 Volume 10, Number 19 (2015) pp 40535-40540.
10. Suma, N. and Purusothaman, T. 'Logical Tree Based Routing for Energy Efficient Wireless Sensor Networks' European Journal of Scientific Research, Vol.87 No 4 October 2012, pp.504-511.
11. Suma, N. and Purusothaman, T. 'Secure Authentication Based Multipath Routing Protocol for WSNs', Journal of theoretical and Applied Information technology, Vol.59 (1) January 2014, pp.222-231.
12. Suma, N. and Purusothaman, T. 'Efficient Multipath Routing Tree based Energy Minimization in Wireless Sensor Networks', Asian Journal of Information Technology, Vol.13 (6), 2014, pp.338-345.
13. Dr.N.Suma and P. KalaiVani. 'In-Situ Water Monitoring Using Portable Sensor', International Journal of Scientific Research in Science, Engineering and Technology, Vol.2 (6), 2016, pp.282-288.
14. Dr. N. Suma and Dr.S.Gopinath, 'Design and Development of Network Reliability based Secure Multicast Routing Protocol for MANET', journal of advances in chemistry, Vol.13 (10), 2017 pp. 6563-6569.
15. Dr.N.Suma ,S.Jayashree , E.Shanthini , "Design of High Speed Architecture of ECSM", Middle-East Journal of Scientific Research 25 (4): 684-689, 2017
16. M. Arun kumar "An Efficient Design and Implementation of Ambient Power Harvesting Method Using Radio Waves for IoT System Monitoring Module", International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 05 May-2018.

AUTHORS PROFILE

M.Arun Kumar is currently working as Assistant Professor in ECE department at Dhanalakshmi Srinivasan College of Engineering, Coimbatore. His area of interest includes Digital Signal Processing, Satellite Communication, Linear Integrated Circuits.

J.R.Nishanth is currently working as Assistant Professor in ECE department at Dhanalakshmi Srinivasan College of Engineering, Coimbatore. His area of interest includes Communication theory, Embedded Systems Microprocessor and Microcontroller.

R.Nivethika is currently working as Asssitant Professor in ECE department at Arjun College of technology, Coimbatore. Her area of interest includes Microprocessor and Microcontroller, Embedded Systems, Electromagnetic Fields.

R.Usha Nandhini is currently working as Asssitant Professor in ECE department at Dhanalakshmi Srinivasan College of Engineering, Coimbatore. Her area of interest includes Electronic Circuits, Electronic devices.