ENERGY HARVESTING FROM RF RADIATION

Anansiya.S[#1],Auxilia Mercy A[#2], Babiyona Lisy F[#3], Pushpalatha M[#4], Vennila M[#5]
(1,2,3,4)UG scholar Electrical and Electronics DMI College Of Engineering, Chennai, Tamil Nadu,
(5)Associated Professor Electrical and Electronics DMI College Of Engineering, Chennai, Tamil Nadu,

Abstract- The demand for power keeps increasing every year by 10-20%. So the ways to generating developing a power in low range (mv) and thus charge a battery which can be utilized for electronic devices. When compared to other methods of energy harvesting, RF has the smallest energy density. He energy harvesting is the process of electronically capturing and accumulating energy from a variety of energy sources deemed wasted or otherwise said to be unusable for any practical purpose. Here the radio frequency signal which are released into the environment as wasted potential energy sources is captured using rectangle patch antenna is converted into DC by using RF to DC converter circuit. In our project, we are utilizing this DC supply to charge the mobile devices again. With addition to that we are converting a DC to AC using inverter circuit in order to provide supply to mini home appliances.

Keywords: RF harvesting ,mobile, ATMEL, ultra thin super capacitor.

I.INTRODUCTION

With the growing popularity and applications of large scale sensor-based wireless networks (eg., structural health monitoring ,human health monitoring ,to name a couple),the need to adopt inexpensive, green communication strategies. Harvesting of ambient energy from variety of natural and man made sources for sustained network. This instrument potentially leading to reduction in costs associated with replacing batteries periodically. There is a strong motivation to enable an off shelf wireless sensor network (WSN) with energy harvesting capability.

The concept of wireless energy harvesting and transfer is not new, rather it was demonstrated over 100 years ago by Tesla. In recent times, RFID technology is a clear example of wireless power transmission where such a tag operates using the incident radio-frequency (RF) power emitted by the transmitter. However , there are limitations in directly porting these approaches to WSN scenarios: The former cannot be scaled down for the small form factor sensors ,while RFID is unable to generate enough energy to run the local processing tasks on the node . There is a visible need for energy harvesting circuit design that can successfully operate a sensor node.

RF ENERGY HARVESTING

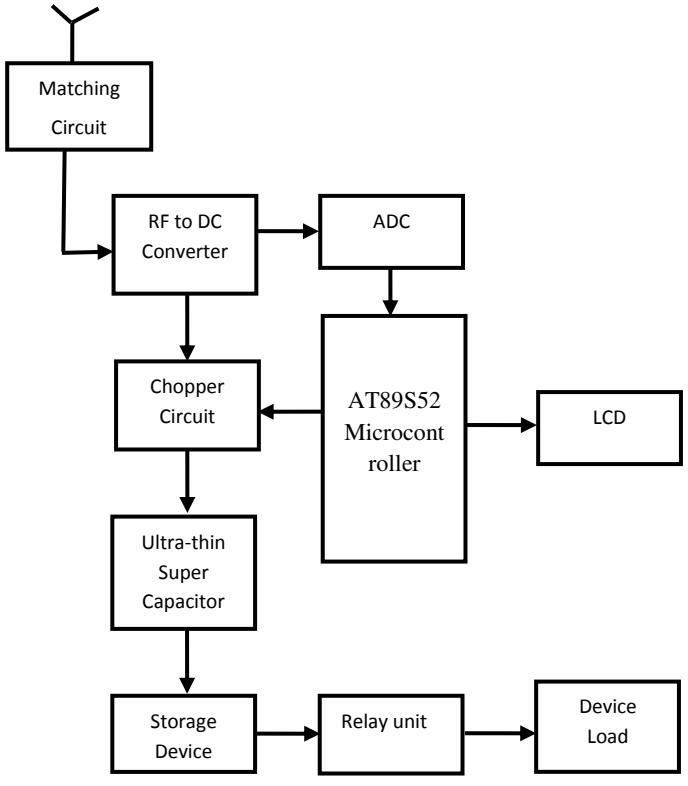

Figure:1

Figure: 1. This shows the concept of our proposed energy harvesting circuit. The RF energy is converted into DC source is then given to the load(mobile).The unusable RF energy is received by antenna which is Omni directional. Here we are using RF energy which is emitted from mobile .The RF energy is given to the Matching network composed of inductive and capacitive element. To match the frequency range of 800 to 900mhz. Then the RF energy is converted into DC source in converter station then the source is given to ADC. From ADC is given to the microcontroller to read the signal ,then it is given to the chopper circuit for boosting .After that the source are given to ultra thin capacitor for maintaining constant voltage. The LCD is used to display the amount of voltage generated. Where the chopper circuit is connected to the ultra thin super capacitor this ultra thin capacitor is used for the purpose of amplification and to improve the life time of the battery. The characteristic of ultra thin capacitor is fast charging and slow discharging. Then it is given to the storage device(battery) for the storage of energy and is connected to the relay circuit for switching operation. Finally the energy where given to the load.

II.RF ENERGY HARVESTING CIRCUIT COMPONENTS

ATMEL89S52

Figure.2

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the Indus-try-standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory pro-grammars. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. The Power-down mode saves the RAM con-tents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset

II.1.ADC

The ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The converter features a high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree and a successive approximation register.

The 8-channel multiplexer can directly access any of 8-single-ended analog signals. The device eliminates the need for external zero and full-scale adjustments. Easy interfacing to microprocessors is provided by the latched and decoded multiplexer address inputs and latched TTL TRI-STATE® outputs. The design of the ADC0808, ADC0809 has been optimized by incorporating the most desirable aspects of several A/D conversion techniques. The ADC0808, ADC0809 offers high speed, high accuracy, minimal temperature dependence, excellent long-term accuracy and repeatability, and consumes minimal power. These features make this device ideally suited to applications from process and machine control to consumer and automotive applications. For 16-channel multiplexer with common output (sample/hold port) see ADC0816 data sheet.

What's the difference between DC and AC electricity

When science teachers explain the basic idea of electricity to us as a flow of electrons, they're usually talking about direct current (DC). We learn that the electrons work a bit like a line of ants, marching along with packets of electrical energy in the same

way that ants carry leaves. That's a good enough analogy for something like a basic flashlight, where we have a circuit (an unbroken electrical loop) linking a battery, a lamp, and a switch and electrical energy is systematically transported from the battery to the lamp until all the battery's energy is depleted.

II.2.ELECTROCHEMICAL DOUBLE LAYER CAPACITOR (EDLCs)

It is also called super capacitors (SC) - are electrochemical capacitors that have high capacitance and high energy density when compared to common capacitors, and higher power density when compared to batteries. Significant improvements in materials, design and the process of production of pulse super capacitors has lead to low profile prismatic devices that can supply high peak currents of up to 2 – 3 A. These devices are suited to meet the peak power demands of many battery-powered electronics and other consumer and industrial devices with current-limited energy sources.

II.3.DC TO DC BOOSTER

A DC-to-DC converter is an electronic circuit which converts a source of direct current (DC) from one voltage level to another. It is a class of power converter. The LM358 series consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

II.4.ULTRA THIN SUPER CAPACITOR

Super capacitors are unique electrical storage devices that can store much more energy than conventional capacitors, and offer higher power density than batteries .Batteries are very inefficient at low temperatures. Their internal resistance increases due to the slower kinetics of the chemical reaction within the battery. The internal resistance is reduced by incorporating a super capacitor into the system with the battery. The internal resistance of pulse type super capacitors is much lower than that of batteries, even at low temperatures down to -40C.

II.5.RELAY

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.

II.6.BATTERY

An electric battery is a device consisting of two or more electrochemical cells that convert stored chemical energy into electrical energy. Each cell contains a positive terminal, or cathode, and a negative terminal, or anode. Electrolytes allow ions to move between the electrodes and terminals, which allows current to flow out of the battery to perform work.

III.SIMULATION

In simulation the input is given 230V which is AC. Then the AC voltage is converted into DC voltage till 12V which is more than enough to charge the mobile. The required voltage level to charge the mobile is 5V.

SIMULATION DESIGN

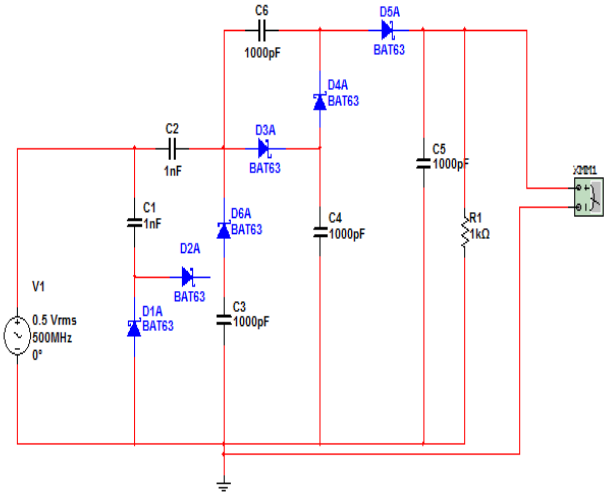

Figure.3

TABLE 1

VALUES OF INPUT AND OUTPUT VOLTAGE

INPUT VOLTAGE	OUTPUT VOLTAGE
AC 230V	DC 12V

III.1. NI MULTISIM

NI Multisim is an electronic schematic capture and simulation program which is part of a suite of circuit design programs, along with NI Ultiboard . Multisim is one of the few circuit design programs to employ original Berkeley SPICE based software simulation. Multisim was originally created by a company named Electronics Workbenh , which is now a division of National Instruments . Multisim includes microcontroller simulation (formerly known as MultiMCU), as well as integrated import and export features to the Printed Circuit Board layout software in the suite, NI Ultiboard . Multisim is widely used in academia and industry for circuits education, electronic schematic design and SPICE simulation.

IV.CONCLUSION

The RF energy is used for the harvesting purpose which is converted into DC and then it is given to the mobile for charging while receiving the call .We show that with a simple yet optimal design and optimization, the prototype can yield almost double the efficiency than that of a major commercially available energy harvesting circuit in the low incident power range (simulation results for the circuit reveal about 70% operational efficiency). The experimental results are in good agreement with the values seen in the nonideal simulation. Currently the major challenge is to reduce the cost, decrease the size and improve the efficiency and the sensitivity of the low power harvesting devices.

REFERENCE

1] N. Tesla, “The transmission of electric energy without wires,” in 13thAnniversary Number of the Electrical World and Engineer, 1904.

[2] J. Curty, M. Declercq, C. Dehollain, and N. Joehl, Design and Optimization of Passive UHF RFID Systems. New York: Springer, 2007.

[3] J. A. Paradiso, “Systems for human-powered mobile computing,” in Proc. 43rd Design Automation Conf. (DAC), Jul. 24–28, 2006, pp.645–650.

[4] C. R. V. Leonov, T. Torfs, P. Fiorini, and C. Van Hoof, “Thermoelectric converters of human warmth for self-powered wireless sensor nodes,” IEEE Sensors J., vol. 7, no. 5, pp. 650–657, May 2007.

[5] K. Lin, J. Yu, J. Hsu, S. Zahedi, D. Lee, J. Friedman, A. Kansal, V.Raghunathan, and M. Srivastava, “Heliomote: Enabling long-lived sensor networks through solar energy harvesting,” in 3rd Int. Conf.

Embedded Networked Sensor Syst., Nov. 2–4, 2005, p. 309.NINTANAVONGSA et al.: DESIGN OPTIMIZATION AND IMPLEMENTATION FOR RF ENERGY HARVESTING CIRCUITS 33

[6] A. Sample and J. R. Smith, “Experimental results with two wireless power transfer systems,” in IEEE Radio Wireless Symp., Jan. 2009, pp. 16–18.

[7] D. W. Harrist, “Wireless battery charging system using radio frequency energy harvesting,” M.S. thesis, Univ. Pittsburgh, Pittsburgh, PA, 2004.

[8] M. M. Tentzeris and Y. Kawahara, “Novel energy harvesting technologies for ICT applications,” in IEEE Int. Symp. Appl. Internet, 2008, pp. 373–376.

[9] T. Ungan and L. M. Reindl, “Harvesting low ambient RF-sources for autonomous measurement systems,” in Proc. IEEE Int. Instrum. Meas. Technol. Conf., May 2008, pp. 62–65.

[10] H. Javaheri and G. Noubir, “iPoint: A platform-independent passive information kiosk for cell phones,” in Proc. 7th IEEE SECON 2010,

Jun. 2010, pp. 1–9.

[11] FCC Codes of Regulation, Part 15 [Online]. Available: http://www. access.gpo.gov/ nara / cfr /waisidx03/

[12] H. Yan, J. G. M. Montero, A. Akhnoukh, L. C. N. de Vreede, and J. N.Burghart, “An integration scheme for RF power harvesting,” presented

at the 8th Annu. Workshop Semiconductor Advances Future Electron.Sensors, Veldhoven, The Netherlands, 2005.

[13] R. Doost, K. Chowdhury, and M. Di Felice, "Routing and link layer protocol design for sensor networks with wireless energy transfer," in

IEEE Globecom, Dec. 2010, pp. 1–5.

[14] J. Curty, N. Joehl, C. Dehollain, and M. Declercq, "Remotely powered addressable UHF RFID integrated system," IEEE J. Solid-State Circuits,

vol. 40, no. 11, pp. 2193–2202, Nov. 2005.

[15] D. Bouchouicha, F. Dupont, M. Latrach, and L. Ventura, "Ambient RF energy harvesting," in IEEE Int. Conf. Renewable Energies Power Quality (ICREPQ'10), Mar. 2010, pp. 486–495.

[16] P2000 Series 902–928 MHz Power harvester Development Kit Powercast Corp. [Online]. Available: http://www.powercastco.com/products/

development-kits/

[17] Wireless Identification and Sensing Platform (WISP), [Online]. Available:http://wisp.wikispaces.com/

[18] Texas Instruments MSP430L092, [Online]. Available: http://www.ti.com/product/msp430l092

[19] H. Ba, I. Demirkol, and W. Heinzelman, "Feasibility and benefits of

passive RFID wake-up radios for wireless sensor networks," in IEEE GolbeCom 2010, Dec. 2010, pp. 1–5.