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Emergency Backup for Cellphone Using RF Power Harvesting

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ABSTRACT

This paper presents the research work on Radio Frequency energy harvesting. Our research work involves a technology that can provide an emergency backup to a cell phone using Radio frequency harvesting. The work presents the device that uses the Radio Frequency energy for charging the cell phones. Such a device can be very useful to charge the mobile phones in remote areas, where the electric power is not easily available .The work describes Radio Frequency harvesting through mobile communication signals and storing the harvested charge in a super capacitor for emergency use.

Key words: Cell phones, Radio Frequency, Energy harvesting, Super capacitor

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INTRODUCTION

The twentieth century resulted a lot of revolutions, especially in the fields of industry, information technology and communication [1]. Many inventions/ discoveries emerged *i.e.* cell phone, Automobile, Personal computers, airplanes etc. Among those cell phone technology created a milestone in a human life. As a result our everyday life has changed radically. Cell phones had become part of a human life and are the perfect way to stay connected with others and provide the user with a sense of security. The importance of cell phones goes way beyond the ability to make or receive phone call. However in the present cell phone technology has been advanced, technology has allowed the cellular phone to shrink not only the size of the ICs, but also the batteries. Though the technology has advanced, still there is a lack in the battery efficiency and this resulted as a main drawback [2]. To overcome this many devices emerged such as, power banks, Turbo charger(for fast charging), etc. but still all these are supporting devices, which is something extra weigh to a person down.

Energy is present everywhere in the environment in different forms such as, thermal energy, light (solar) energy, wind energy, and mechanical energy. However, the energy available from these sources is inadequate power for any viable purpose [4]. In fact, until recently, it has not been possible to capture such energy sufficiently to perform any useful work.

In the proposed work Radio frequency (RF) energy reaping, also referred to as RF energy scavenging is used for charging of the mobile phones in emergency conditions. Radio frequency (RF) waves are electromagnetic waves that originate at a transmitter in the form of a photon that is oscillating within one of the pre-determined transmission frequency bands such as UHF, SHF, or VHF, etc [3].

SYSTEM ARCHITECTURE

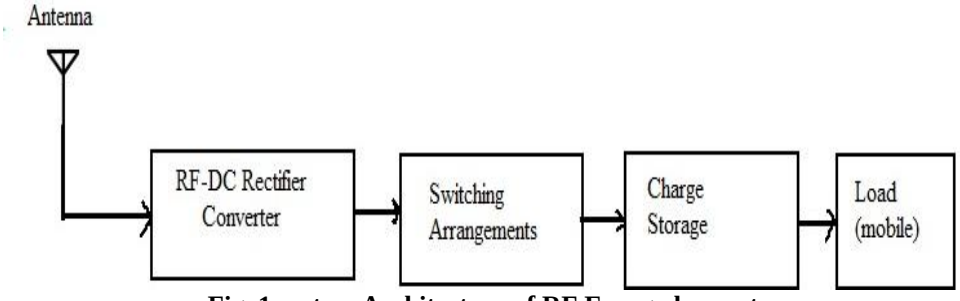

Fig. 1 system Architecture of RF Energy harvester

The above fig shows System architecture for charging mobile

- Antenna
- RF-DC conversion
- Switching arrangements
- Charge storage
- Load(mobile)

Antenna:

The first stage in the energy harvester is antenna design. A Simple copper wire is taken & Calculated the length of wire, by dividing 143 by the frequency you wish the antenna to be tuned to in megahertz, antenna is made by using simple copper wire that has a number of advantages over other antennas: it is lightweight, inexpensive.

RF-DC conversion:

Diode based circuits can be used to multiply and rectify AC voltages circuit, For Germanium diodes, it will conduct at a forward voltage of only about 0.15V, however, a silicon diode will not start to conduct until a forward voltage of 0.6V is reached Thus, primarily due to low threshold voltage of the Germanium diodes and sometimes known as signal diodes, this type of diode is well suited for RF signal harvesting. The capacitor will smoothen the DC rectified signal into ripple voltages of the proposed RF to DC energy harvester circuit.

Switching Arrangements:

Since there is no circuit arrangement available for charging capacitor parallel & discharge serially. We require switching of circuit by using switching arrangements where it uses manual switch for switching purpose.

Charge Storage:

Since the harvested voltage is very low that is insufficient to charge a mobile. So we store this small amount of charge in two successive super capacitor parallel and take their output serially to get required voltage for charging mobile during emergency.

CIRCUIT DIAGRAM

Antenna:

Antenna are used to pick RF signals and convert them corresponding AC voltage. In RF energy harvesting for charging mobile we used simple copper wire antenna to pick RF signals from mobile network signals and convert it to AC voltage feed it to corresponding multiplier & rectifier circuit for further process.

Fig. 2a simple Copper wire antenna

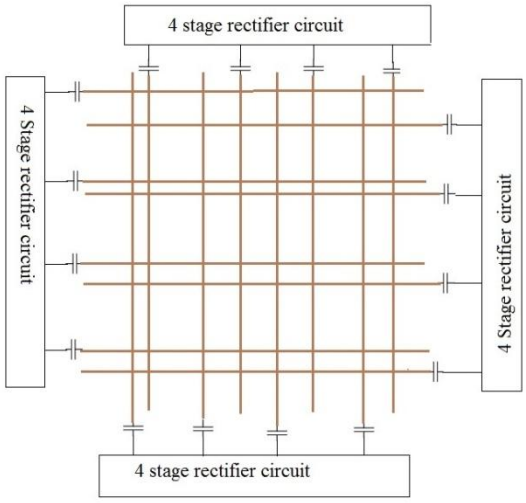

Fig. 2b Implementation of simple copper wire antenna

RF-DC Conversion Circuit:

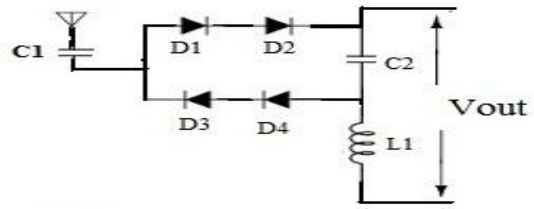

Fig. 3 single stage Multiplier & Rectifier circuit

In diode based multiplier &rectifier, as demonstrated in Figure it is single stage circuit, for charging cell phone it requires more voltage hence 16 stages are built to harvest more voltage. The input RF signal is in the form of AC signal

is converted in to dc signal for the half cycles, the D1 D3 is for positive cycle and D2 D4 is for negative cycle, capacitors are used for charging and discharging. The input voltage is multiplied by the number of stages. Considering an ideal case where the voltage drop on each diode (D) equals 0, the output voltage can be calculated as:

$$Vdc\_Out=N*Vin$$

However, in the low power harvesting the voltage drop across diode cannot be ignored and the output voltage becomes:

$$Vout=N(Vin-Vth)$$

Where Vth is the threshold voltage of a diode, N is the number of rectifier stages.

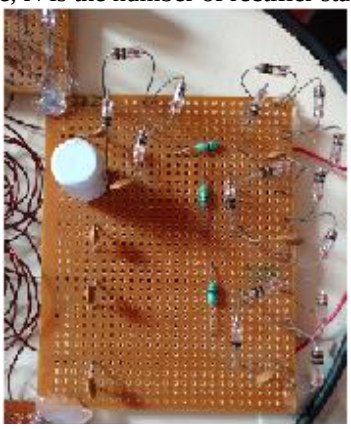

Fig. 4 4 stage rectifier circuit

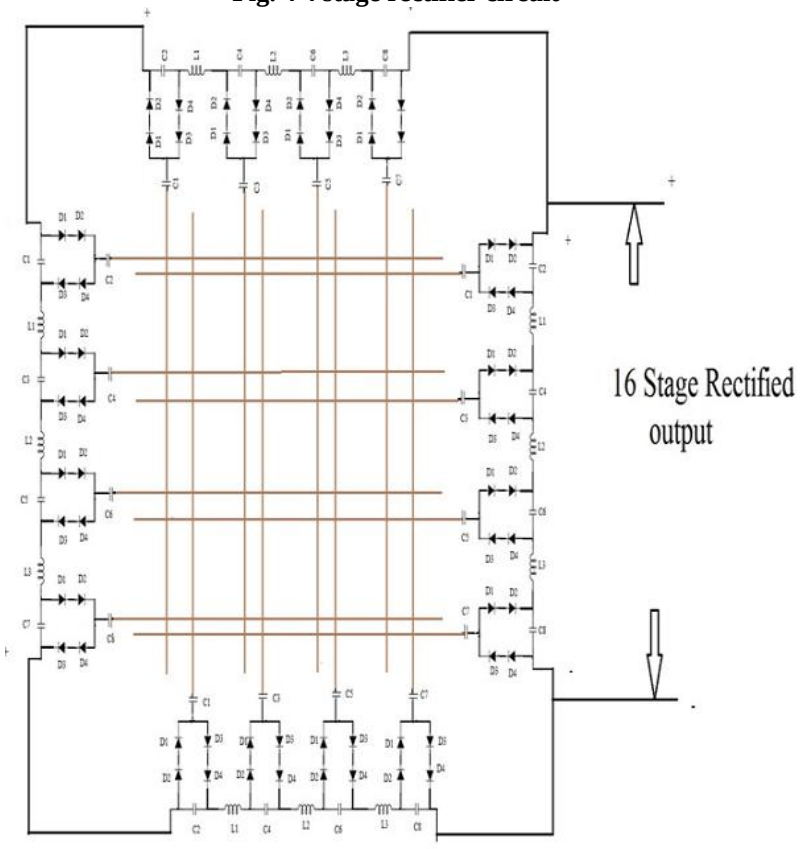

Fig. 5 Implementation of 16 stage Rectifier circuit

Switching Arrangements Circuit:

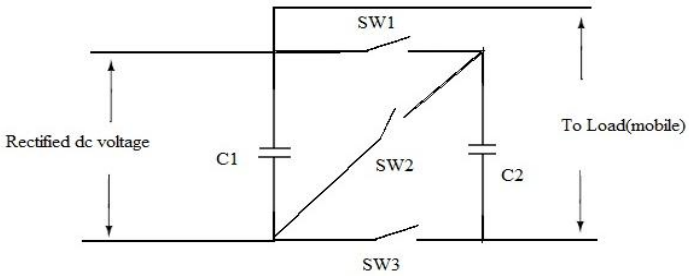

Fig. 6 Switching arrangements circuit

Above figure shows the circuit arrangement of parallel charging super capacitor and discharging serially .Since we don't get any circuit configuration to satisfy above case we need to use switching action .we are using simple switches for manually switching the circuit.

Operation:

Case 1:

When SW1 and SW3 are ON and SW2 is OFF the two capacitor charges parallel

Case 2:

When SW2 is ON and SW1,SW3 are OFF the both capacitor discharges serially

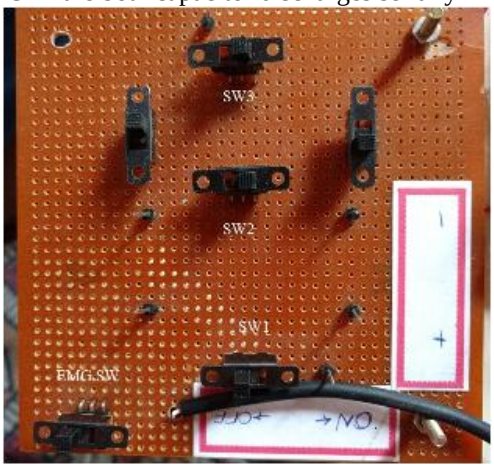

Fig. 7 Implementations of Switching arrangements

COMPONENTS USED

Hardware:

Diode(OA79), Inductor (1 micro Henry), Capacitor(0.1 micro Farad), Super capacitor & Copper wire for antenna

FLOW DIAGRAM

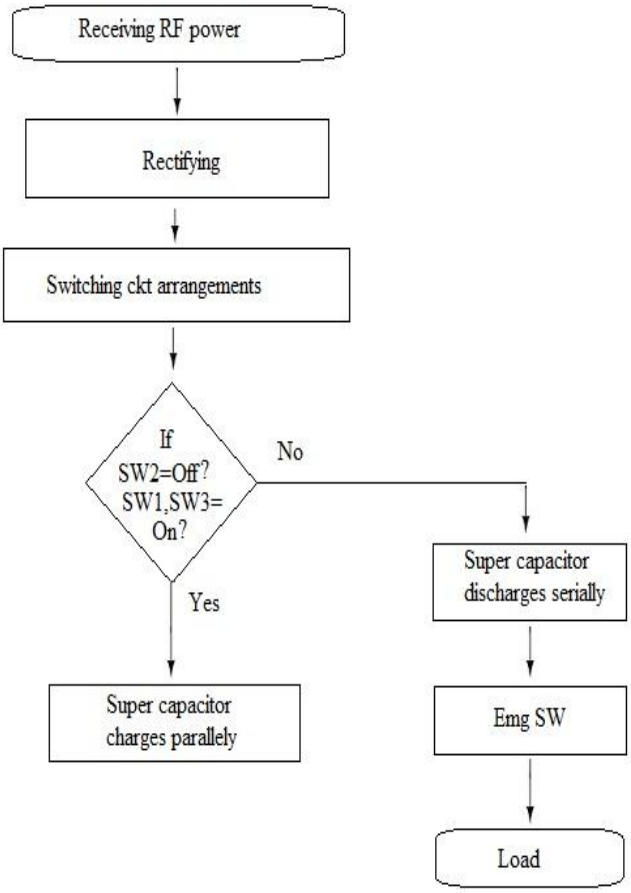

Fig. 8 Proposed system Flow diagram

RESULTS AND DISCUSSION

Prototype Implementation

It was shown that while an energy harvesting board could not give sufficient power to charge the battery while it was in the phone, it did a good job of charging just the super capacitor. With that in mind, it was decided to go forward with the fabrication of a second board that would fit this circuit would be simple to charge super capacitor parallel and take their output serially this being the case, the board was designed mainly for storing harvested voltage and used when ever in emergency condition arises.

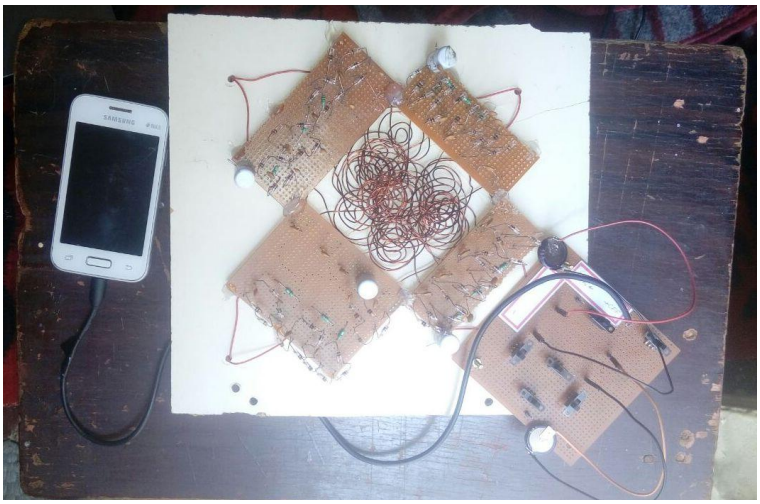

Fig. 9 Implementation of prototype

Prototype Testing:

With mobile placed on antenna and keep on calling the mobile which placed generates the voltage of 1.5v. This harvested voltage is fed to switching arrangement circuit in order to store harvested voltage, where the two capacitor charges .The switching arrangements circuit consist of 3 SW as shown below fig

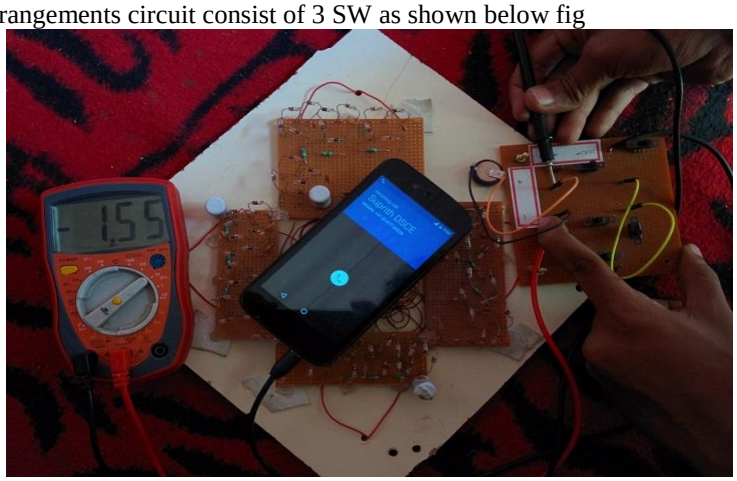

Fig. 10 Voltage across RF circuit with load (1.5v)

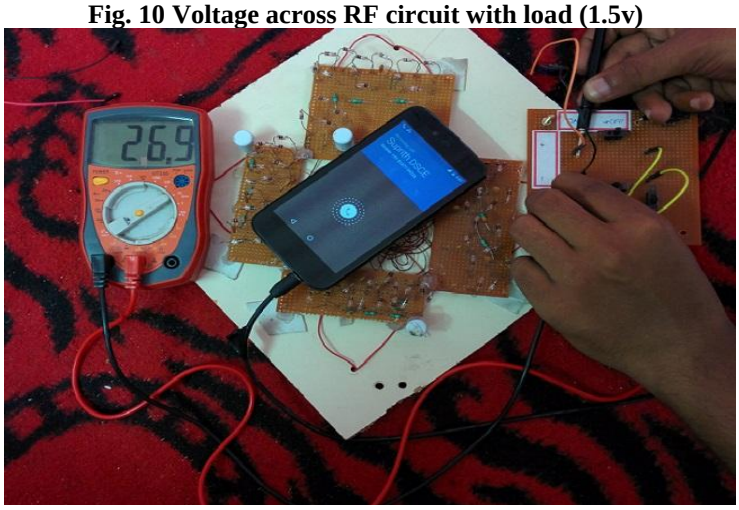

Fig. 11 Voltage across RF circuit without load (26.9v)

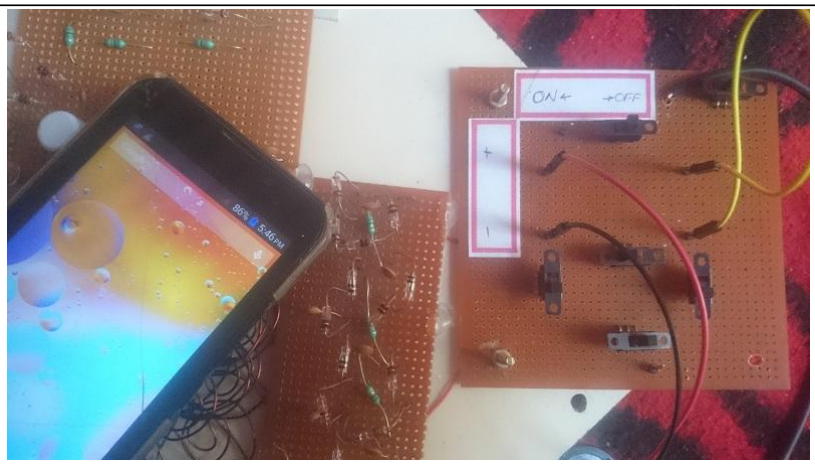

Fig. 12 Charging of cell phone

Case 1:
When SW1 and SW3 are ON and SW2 is OFF the two capacitor charges parallel.
Case 2:
When SW2 is ON and SW1, SW3 are OFF the both capacitor discharges serially
During emergency condition like battery got exhausted means, the EMG switch is turned on and cell phone gets charges.

ADVANTAGES

1. Simple circuit design to harvest RF energy.
2. Simple use of passive components for harvesting circuit.
3. Low cost.
4. Less complexity of circuit design.

FUTURE SCOPE

Some issues remain that need to be studied before work can continue. The first thing to look at is the antenna being used to harvest the RF energy. As explained above, the antenna used is simple copper wire antenna, There needs to be much more significance put on antenna design in order to get the power transfer to a sufficiently high level. Another thing to consider is the circuit itself. Perhaps there are other ways of executing out the circuit that could be more power-efficient.
The last thing to try would be to be able to involve the cellular phone company directly or at least be willing to discover the circuitry involved.

CONCLUSIONS

In this research work, we developed the device to provide the backup to cell using mobile RF signal, Experimental results show that while we completely successful of harvesting RF signals from cell phone during calling mode and we have completed the goal of being able to charge the battery with super capacitor. Out foxing the circuitry in the charging path will allow future adaptation of the RF energy harvesting concept produced by this research in cell phones.

REFERENCES

[1]. Parvizso Aminov and Jia P. Agrawal, "RF energy Harvesting", *IEEE Electronic Components & Technology Conference*, **2014.**
[2]. S.N. Deepa, B.Shamili Swarupa Rani, "RF Energy Harvesting Using 900MHz of Mobile Signal Frequency to Charging the Mobile Battery", *IEEE International Conference on Innovations in Green Energy and Healthcare Technologies*(ICIGEHT'17), **2017.**
[3]. Tolga Soyata, Lucian Copeland, and Wendi Heinzelman "RF Energy Harvesting for Embedded Systems: A Survey of Trade offs and Methodology", IEEE circuits and systems magazine, Date of publication: 12 February **2016.**
[4]. C. R. Valenta and G. D. Durgin, "Harvesting wireless power: Survey of energy-harvester conversion efficiency in far-field, wireless power transfer systems," *IEEE Microw*. Mag., June **2014,** vol. 15, no. 4, pp. 108–120.
[5]. L. Xiao, P. Wang, D. Niyato, D. Kim, and Z. Han, "Wireless networks with RF energy harvesting: A contemporary survey."
[6]. J. Paradiso and T. Starner, "Energy scavenging for mobile and wireless electronics," *IEEE Pervasive Comput*., **2005,** vol. 4, no. 1, pp. 18–27,.

[7]. G. Honan, N. Gekakis, M. Hassanalieragh, A. Nadeau, G. Sharma, and T. Soyata, "Energy harvesting and buffering for cyber physical systems: A review," in Cyber Physical Systems - A Computational Perspective, **2015**, CRC, ch. 7.

[8]. K. S. Rao, P. V. Nikitin, and S. F. Lam, "Antenna design for UHF RFID tags: A review and a practical application," *IEEE Trans. Antennas Propag*ations., **2005**,vol. 53, no. 12, pp. 3870–3876.