Bio-Medical Application of Wireless Power Transmission System

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***Abstract*—This paper presents the wireless power transmission system is separated into three main components, the transceiver, the inductive coils and the RF/DC converter. Simple examines were done to check the model and simulations were done to display the benefit of wireless power transmission which also avoids accidents related to large wires and no adequate grounding. To increase the quality of diagnosis, some main specifications such as image resolution, frame rate and working time need to be developed. Moreover, future multi-functioning robotic capsule endoscopy units may consume advanced features such as energetic system control over capsule motion, drug delivery systems, semi-surgical tools and biopsy. However, the addition of the above innovative features demands extrapower that makes conventional power source methods are difficult. In this regards, wireless power transmission system has received attention among researchers to overcome this problem. This paper defines the reviews on techniques of using wireless power transmission for bio-medical applications.**

***Keywords*—Wireless power transfer, bio-medical application, transformer inductive coupling, wireless electricity, energy transfer, radiation.**

1. INTRODUCTION

The main idea of transmitting power through the air has been about for over a century, with Nikola Tesla's pioneering ideas and examine perhaps being the most well-known early attempts to do so [1]. He had a vision of wireless distributing power over bulky distances using the earth's ionosphere. Most schemes are established to wireless power transfer use of an electromagnetic field of some frequency as the means by which the energy is sent. At the high frequency end of the spectrum are optical systems that use lasers to send power via a collimated beam of light to a remote

detector where the received photons are transformed to electrical energy. Efficient transmission over bulky distances is possible with this approach, however, difficult pointing and tracking mechanisms are required to maintain proper alignment between moving transmitters or receivers. In accumulation, substances that get between the transmitter and receiver can block the beam, disturbing the power transmission and depends on the power level, probably affecting harm. At microwave frequencies, a similar method can be used to efficiently transmit power over bulky distances using the radiated electromagnetic field from appropriate antennas [2, 3]. However, related caveats about safety and system difficulty apply for these radiative approaches. Initially cordless phones were introduced, then wireless internet. The next phase to making our lives actually mobile is getting rid of the tangles of power cables lurking in all our homes. Unless you are mainly organized and good with draw wrap, you possibly have a little dusty power cord tangles around your home. You may have even had to follow one particular cord through the seemingly difficult snarl to the outlet, hoping that the plug you pull will be the exact one. This is one of the falls of electricity.

While it can make people's lives easier, it can mix a lot of disorder in the process. Moreover a great concern has been voiced in recent years over the wide use of energy, **the** restricted supply of resources and the pollution of the environment from the use of present energy conversion methodologies. Much of this power is lost during transmission from power plant creators to the user. The resistance of the cable used in the electrical network distribution system causes a loss of 26-30% of the energy generated. This loss indicates that our present system of electrical distribution is only 70-74% efficient. A system of power distribution with tiny or no loss would conserve energy. It would decrease pollution and expenses resulting from the required to generate power to overcome and recompense for losses in the present grid system.

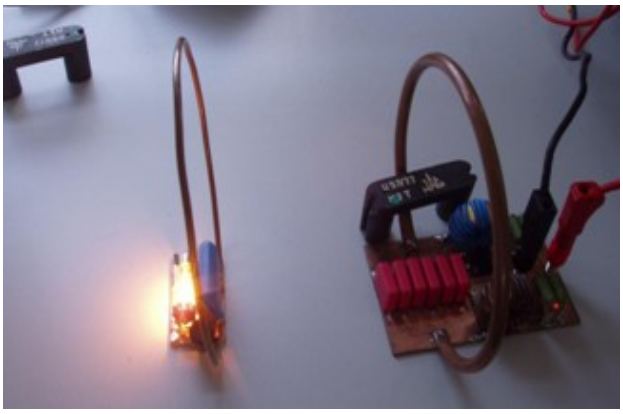

Figure 1: A wireless power transfer system

For these reasons, scientists have tried to improve methods of wireless power transmission that could cut the clutter or lead to clean sources of electricity. We can term it as Witricity. The guarantee of wireless electricity has been around for over 100 years. Nikola Tesla consumed much of his productive life testing with wireless power. The familiar tesla coils are actually a resonant wireless power transmitter [2]. Figure 1 shows the basic articulation of wireless power transfer mechanism, by which the uses of wires are avoided. The design challenge of battery fewer implantable devices is the few available power, which loads the use of low power on-chip circuitry, including the data transceiver, regulator, and secondary circuitry.

II.CONCEPT OF WIRELESS POWER TRANSFER

The main attention in extremely resonant wireless power transfer comes from many marketplaces and application sectors. There are several inspirations for using such technology, and these often drop into one or more of the following categories: 1) Make devices more suitable and thus more desirable to purchasers, by removing the need for a power cord or battery spare. 2) Make devices more consistent by removing the most failure prone component in most electronic systems—the cords and

connectors. 3) Create devices more globally sound by eliminating the required for throwaway batteries. Using grid power is much fewer expensive and more globally sound than manufacturing, transporting, and using batteries based on conventional electro-chemistry. 4) Create devices safer by removing the sparking hazard associated with conductive interconnections, and by making them water-tight and explosion proof by removing connector headers and wires that run through roofs, walls or other barriers.5) Decrease the system cost by leveraging the capability to power several devices from a single source resonator. The high grade of scalability of power stages and distance range in solutions depends on highly resonant wireless power transference enables a very different collection of arrangements. Applications range from very few power levels for wireless sensor and electronic devices needed less than 1 watt, to very high power stages for industrialized systems and electrical vehicles requiring in excess of 3 kilowatts. WiTricity is one of the wireless electricity. Communication of electrical energy from one object to other without the use of cables is called as WiTricity. WiTricity will confirm that the cellphones, laptop, iPod and other power hungry devices get charged on their own, removing the need of plugging them in (Figure 2 and Figure 3). Even better, because of WiTricity some of the devices need not require batteries to operate. Wireless electricity is the process that takes place in any system where electrical energy is transferred from a power source to an electrical load without interconnecting cables.We can also call it as wireless energy transfer or wireless power communication. This technology eliminates the use 40 billion disposable batteries built every year for power that is used within a few inches or feet of where there is very low-cost power.

Figure 2: Basic phenomenon of witricity

Figure 3: Wireless charging of devices

III. THE CONCEPT BEHIND WIRELESS ELECTRICITY

Wireless transmission is ideal in cases where sudden or continuous energy transfer is required. The possible applications of wireless power transfer comprise charging of mobile phones and laptops, radio-frequency identification (RFID), electrically charge vehicles, biomedical sensors, space solar power satellite (SPS), solar energy to earth, and in spying circuits devices which if cover a power source can have greater probability of detection etc. The principle behind wireless electricity is "Coupled Resonance". Magnetic coupling arises when two objects interchange energy through their changing or fluctuating magnetic fields. Resonant coupling arises when the natural frequencies of the two objects are nearly the same. WiTricity power sources and capture devices are specifically designed magnetic resonators that competently transfer power over bulky distances via the magnetic near-field.

These proprietary source and device strategies and the electronic systems that regulate them support efficient energy transfer over distances that are several times the size of the sources and devices themselves. Consider the two self-resonating copper coils of same resonating frequency with a diameter 20 inches each. One copper coil is connected to the power source (WiTricity transmitter), while the other copper coil is connected to the device (WiTricity Receiver) (Figure 4).Furthermore a capacitance plate which holds charges is attached to each end of the coil to improve the range of transmission. The resonant frequency is a product of the inductance coil and the capacitanceplates, therefore the range of transmission is increased [3].

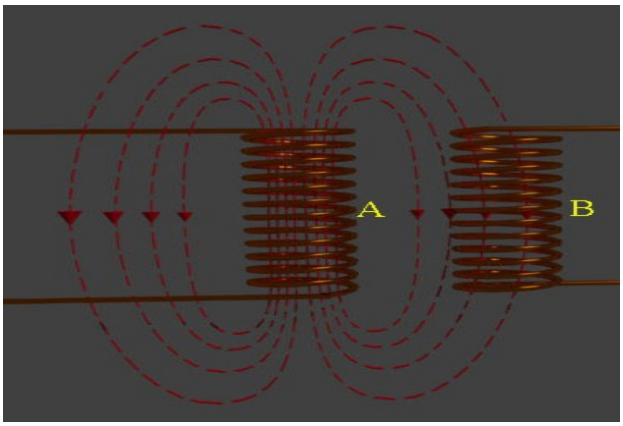

Figure 4: Resonant magnetic coils

The electric power from the power source causes the copper coil connected to it to start fluctuating at a particular (MHz) frequency. Consequently, the space around the copper coil gets filled with non-magnetic radiations. This created magnetic field further transfers the power to the other copper coil linked to the receiver. Since this coil is also the same frequency, it starts fluctuating at the same frequency as the first coil.

This is called as'coupled resonance' and is the principle behind schedule the WiTricity. There are variety of systems to transmit power without wires. Omni-directional radiative antennas are one of the greatest extensively used technologies, since they can function in all orders and do not need a line of sight to the receiver, they are highly inefficient. Only a little portion of the emitted power in the direction of the receiver is essentially picked up, since the huge majority of the energy is lost in all the other directions. The use of a greatly directional antenna, such as a microwave-beam

antenna, in principle solves this problem and attains a high efficiency in power transmission even over lengthy distance (kilometres). On the additional hand, this type of antenna does need an uninterrupted line of sight, which in itself requires a complicated device-tracking and beam-steering mechanism [4-7]. Also, high-power focused beams may establish a safety hazard. An approach to antennas is the use of an inductive transformer, a device usually used in power circuits and electromechanical. The transformer coupling structure is shown in figure 5.

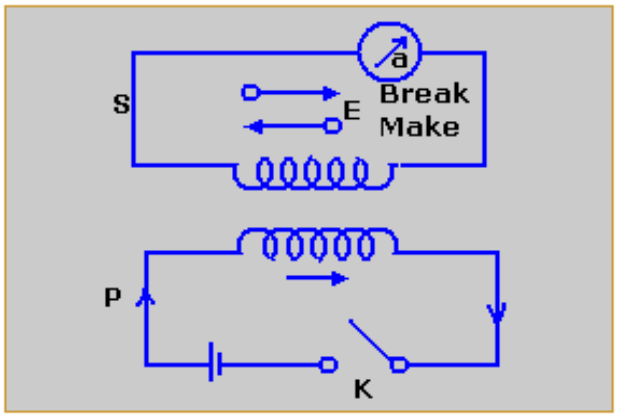

Figure 5: Inductive coupling

A transformer normally operates up to mid-kHz frequencies [8-10]. It fundamentally transfers electrical energy from one circuit to another through induction. The time-varying magnetic flux created by a primary coil crosses a secondary coil and induces a voltage in its secondary side. The primary and the secondary coils are not actually connected, hence the method is wireless. Transformers can be very capablebut the distance between the coils must be very lesser. For distances a little times the size of the coils, the effectiveness drops significantly [11-14].

Part of the underlying physics for most of the existing approaches for the wireless transfer of electricity is the basic principle of resonance. The property of certain physical systems to fluctuate with maximum amplitudes at certain frequencies. Based on scientist Nicola Tesla planned theories of wireless power transmission, researchers have established several techniques for moving electricity over long distances without wires. This technique of transferring electric power is based on the principle of Inductive coupling. An example for current day WiTricity, a toothbrush's daily exposure to water makes a traditional plug-in charger potentially dangerous.

Ordinary electrical connections could also permit water to seep into the toothbrush, damaging its components. Another example for current day WiTricity is the Splash power recharging mat and Edison Electric's Power desk both use coils to generate a magnetic field. Electronic devices use corresponding built-in or plug-in receivers to recharge while resting on the mat. These receivers comprise compatible coils and the circuitry needed to deliver electricity to devices batteries [8-10].

IV. MEDICAL APPLICATIONS

Millions of people around the world advantage from having artificial pacemakers implanted into their chests, to help restore a normal heartbeat is shown in figure 6.Yet pacemakers are not without problems. The bulk of the device-which comprises its battery and electronic control systems-usually,sits just under the wearer's skin. From this box thin, flexible leads are threaded through a vein and into the appropriate part of the heart. These leads detect the heart's electrical activity [14].Fitting the body of an artificial pacemaker is fairly easy.

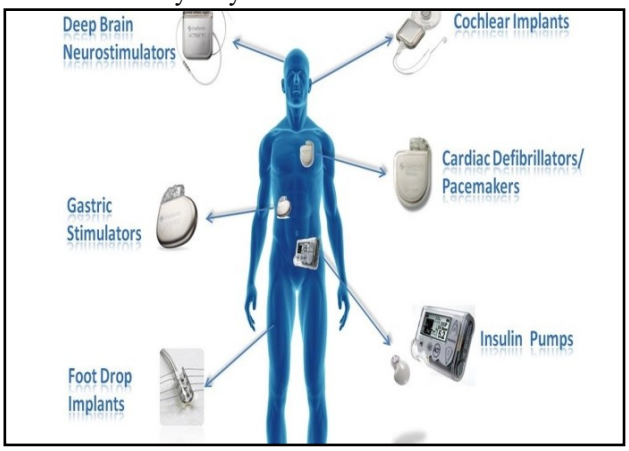

Figure 6: Medical applications

As a solution to that, Medtronic is using microelectronics to create a pacemaker so small it can be inserted. It is said to be the size of a tic-tac only. Medtronic is making the device safer as well as smaller. At just a fraction of the size of current devices, the new pacemaker could be injected using a catheter and a small incision. No more need to slice open the upper chest and create a pocket to hold the pacemaker. No more need to run leads down veins into the heart. A single incision, a single implantation of a tiny device, and Medtronic's future patients would be done.

V. Conclusion

There are hundreds of thousands of people with pacemakers in the world, tens of thousands with brain implants, millions total who have corrective implants of some variety (for diabetes, deafness, etc.). Looking past this pacemaker, we believe that there are even lesser and more capable devices on our horizon.Millions of people around the world advantage from having artificial pacemakers implanted into their chests, to help restore a normal heartbeat. This paper describes the reviews on techniques of using wireless power transmission for bio-medical applications.

References

[1] Hiroshi Matsumoto, "Microwave Power Transmission from Space and Related Nonlinear Plasma Effects" Space and Radio Science Symposium: 75th Anniversary of URSI, 26-27 April 1995.

[2] W.C. Brown, "Experiments Involving a Microwave Beam to Power and Position a Helicopter", IEEE Transactions on Aerospace Electronic Systems. Vol. AES-5, no. 5, pp 692-702

[3] W.C. Brown, IEEE Transactions on Microwave Theory and Techniques, vol. MTT-32, 1230 (1984).

[4] Balakumar N, 2016, 'A Novel Study of and Comparative Survey of Future Wireless Communication', International Conference on Systems, Science, Control, Communication, Engineering and Technology, Volume 2, pp. 30-35.