Witricity – college essay

A SEMINOR REPORT ON WITRICITY Submitted to JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, Anantapur In partial fulfillment of award of the degree of Bachelor of Technology IN ELECTRICAL AND ELECTRONICS ENGINEERING BY D. SANDEEP KUMAR 05P11A0255 [pic] DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING CHADALAWADA RAMANAMMA ENGINEERING COLLEGE (Affiliated to J. N. T. U, ANANTAPUR) TIRUPATI-517506 2009 ABSTRACT Human brains always search for the new ways and means which makes life easy and simple. Over the past years great scientists invented great things which changed the world completely and effectively.

Even then the thrust for the new inventions was not fulfilled. So many new things are dumped in to the market time-to-time. Among those electronic gadgets have major share. Now a days our life depends much on electronic devices. All these devices have different cables and pins for their operation. We have to insert those cables in the sockets for the supply and also some times to recharge some of the devices. Let us take an example as cell phone. We have to charge it time to time other wise it will be switched off. So we use a cable to charge it.

If we forget that we will loss some thing. Similarly all the electronic gadgets depend on cables for their operation. Imagine if all the gadgets take care of themselves and become independent of cables. It will be a great and very useful thing to implement. A professor from MIT named MARIN SOLJACIC had this wonderful thought and with the help of some other members found one interesting concept called WITRICITY. Witricity is a portmanteau for wireless

electricity. This concept laid the way to get rid of the wires and cables.

INTRODUCTION

Electricity is today a necessity of modern life. It is difficult to imagine passing a day without electricity. The conventional use of electricity is made possible through the use of wires. However researchers in MIT have devised a means of providing electricity without any wires. These researchers coined the term WITRICITY, which is basically a portmanteau for wireless electricity. This principle of wireless electricity works on the principle of using coupled resonant objects for the transference of electricity to objects without the use of any wires.

A Witricity system consists of a Witricity transmitter and another device called the receiver. The receiver works on the same principle as radio receivers where the device has to be in the range of the transmitter. It is with the help of resonant magnetic fields that Witricity produces electricity, while reducing the wastage of power. This is unlike the principle adopted by Nikola Tesla in the later part of the 19th century; where conduction based systems were used. The present project on Witricity aims at power transmissions in the range of 100 watts.

May be the products using WITRICITY in future might be called Witric or Witric’s. So far the MIT researchers have been able to power a 60 watt light bulb from a power source that is located about seven feet away, while providing forty percent efficiency. This was made possible using two copper coils that were twenty inches in diameter which were designed so that they resonated together in the MHz range. One of these coils were connected to a

power source while the other, to a bulb. With this witricity setup, the bulb got powered even when the coils were not in sight.

Resonant induction: In November 2006, Marin Soljacic and other researchers at the Massachusetts Institute of Technology applied the near field behavior well known in electromagnetic theory to a wireless power transmission concept based on strongly-coupled resonators. In a theoretical analysis (see Ref: Annals of Physics), they demonstrate that, by designing electromagnetic resonators that suffer minimal loss due to radiation and absorption and have a near field with mid-range extent (namely a few times the resonator size), mid-range efficient wireless energy-transfer is possible.

The reason is that, if two such resonant objects are brought in mid-range proximity, their near fields (consisting of so-called ‘ evanescent waves’) couple (evanescent wave coupling) and can allow the energy to tunnel/transfer from one object to the other within times much shorter than all loss times, which were designed to be long, and thus with the maximum possible energy-transfer efficiency. Since the resonant wavelength is much larger than the resonators, the field can circumvent extraneous objects in the vicinity and thus this mid-range energy-transfer scheme does not require line-of-sight.

By utilizing in particular the magnetic field to achieve the coupling, this method can be safe, since magnetic fields interact weakly with living organisms. [pic] 1) Power from mains to antenna, which is made of copper 2) Antenna resonates at a frequency of 6. 4MHz, emitting electromagnetic waves 3) ‘ Tails’ of energy from antenna ‘ tunnel’ up to 5m (16. 4ft) 4)

Electricity picked up by laptop’s antenna, which must also be resonating at 6. 4MHz.

Energy used to re-charge device 5) Energy not transferred to laptop re-absorbed by source antenna. People/other objects not affected as not resonating at 6. 4MHz On June 7, 2007, it was reported that a prototype system had been implemented. In an experimental demonstration (see Ref: Science), the MIT researchers successfully demonstrated the ability to power a 60-watt light bulb wirelessly using two copper coils of 60cm diameter that were 2m (7ft) away at roughly 45% efficiency.

The coils were designed to resonate together at 10MHz and were oriented along the same axis. One was connected inductively to a power source, and the other one to a bulb. The setup powered the bulb on, even when the direct line of sight was blocked using a wooden panel. “ Resonant inductive coupling” has key implications in solving the two main problems associated with non-resonant inductive coupling and electromagnetic radiation, one of which is caused by the other; distance and efficiency.

Electromagnetic induction works on the principle of a primary coil generating a predominantly magnetic field and a secondary coil being within that field so a current is induced within its coils. This causes the relatively short range due to the amount of power required to produce an electromagnetic field. Over greater distances the non-resonant induction method is inefficient and wastes much of the transmitted energy just to increase range.

This is where the resonance comes in and helps efficiency dramatically by “ tunneling” the magnetic field to a receiver coil that resonates at the same

frequency. Unlike the multiple-layer secondary of a non-resonant transformer, such receiving coils are single layer solenoids with closely spaced capacitor plates on each end, which in combination allow the coil to be tuned to the transmitter frequency thereby eliminating the wide energy wasting “ wave problem” and allowing the energy used to focus in on a specific frequency increasing the range.

Beginning in the early 1960s resonant inductive wireless energy transfer was used successfully in implantable medical devices [14] including such devices as pacemakers and artificial hearts. While the early systems used a resonant receiver coil later systems implemented resonant transmitter coils as well. These medical devices are designed for high efficiency using low power electronics while efficiently accommodating some misalignment and dynamic twisting of the coils. The separation between the coils in implantable applications is commonly less than 20 cm.

Today resonant inductive energy transfer is regularly used for providing electric power in many commercially available medical implantable devices. Wireless electric energy transfer for experimentally powering electric automobiles and buses is a higher power application (> 10kW) of resonant inductive energy transfer. High power levels are required for rapid recharging and high energy transfer efficiency is required both for operational economy and to avoid negative environmental impact of the system.

An experimental electrified roadway test track built circa 1990 achieved 80% energy efficiency While recharging the battery of a prototype bus at a

specially equipped bus stop, the bus could be outfitted with a retractable receiving coil for greater coil clearance when moving. [pic] [pic] The gap between the transmitter and receiver coils was designed to be less than 10 cm when powered. In addition to buses the use of wireless transfer has been investigated for recharging electric automobiles in parking spots and garages as well.

Some of these wireless resonant inductive devices operate at low mill watt power levels and are battery powered. Others operate at higher kilowatt power levels. Current implantable medical and road electrification device designs achieve more than 75% transfer efficiency at an operating distance between the transmitting and receiving coils of less than 10 cm. Inventors of Witricity: The inventors of witricity are the researchers from the team from Massachusetts Institute of Technology. They are the people who had coined the phrase of witricity and this invention can change the way electricity is used today.

With witricity, the tangle of cables, plugs and charters that normally clutter homes can be rid of. This team from MIT belonged to the Department of Physics, Department of Electrical Engineering and Computer Science and the Institute for Soldier Nanotechnologies. The members of this team were Andre Kurs, Aristeidis Karalis, Prof. Peter Fisher, Robert Moffatt and Prof. John Joannopoulos. The leader of this team of researchers was Prof. Marin Soljacic. [pic] [pic] It was Prof. Marin Soljacic who provided the inspiration for the experiment and invention of witricity.

It was while standing in the kitchen one night, that on staring at his mobile phone that he had thought it would be nice if his mobile phone would take care of its own charging instead of him having to periodically charge it. He then tried out his experiment using two coils of copper, where one was connected to a receiver, and the other to a transmitter. With the help of these two coils of copper, the inventors of witricity managed to transmit power across seven feet through the air to instantly light up a light bulb. Though witricity worked only distances up till 9 eet at its inception, the inventors believed that it was possible to charge a battery that was located at a distance of a few yards from the power source that was connected to the receiving coil. They state that it would be sufficient to place a source in each room to provide power to the whole house. First Experiment of Witricity: The first experiment of witricity, the concept of wireless electricity, was conducted in the year 2006, by researchers from Massachusetts Institute of Technology. The Assistant Professor of this team of researchers was Marin Soljacic. pic] [pic] [pic] This experiment was done using two copper coils of diameter two feet, a transmitter that was attached to a power source and a receiver that was placed about seven feet from the transmitter. This receiver was attached to a light bulb and once power was switched on at the transmitter, the bulb lit up despite there being no physical connection between the transmitter and receiver. Data collected through measurements showed that there was transference of 40% of electricity through witricity.

The interesting part of the electricity was that the bulb glowed despite the fact that wood, metal and other devices were placed in between the two coils. This concept of witricity was made possible using resonance where an

object vibrates with the application of a certain frequency of energy. So two objects having similar resonance tends to exchange energy without causing any effects on the surrounding objects. Just like in acoustic resonance, where there is a chance of a glass breaking if you strike the right tone, witricity is made possible with the resonance of low frequency electromagnetic waves.

In this experiment, the coils were resonated at 10 MHz where the cols coupled and energy made to flow between them. With each cycle, more pressure and voltage built up in the coil till the accumulation of voltage provided enough pressure and energy to flow to the light bulb. These low frequency electromagnetic waves are rather safe as though the body responds strongly to electric fields; it has almost zero response to absorbing power from a magnetic field. Witricity Power Applications: Researchers from the Massachusetts Institute of Technology have devised a means of transferring electricity without using any wires.

They have dubbed this technology as witricity and have declared that there are many potential applications for it. Some of these potential applications include the powering of cell phones, household robots, laptops and other devices that normally run with the help of batteries or with plugging in of wires. [pic] [pic] As witricity is in the developmental stage, lots of work is still to be done in improving it as the device used for their research disclosed that witricity power applications operate at only 40% efficiency.

The potential applications of witricity are expected to materialize in the new future, of say a few years' time, after the necessary modifications are made to them. These witricity applications are expected to work on the gadgets

that are in close proximity to a source of wireless power wherein the gadget charges automatically without necessarily having to get plugged in. There are no limitations in witricity power applications where anything and everything that used to run with batteries or electrical connections can be used using witricity.

Just imagine, the future witricity power applications permit you to use wireless energy, without having to replace or recharge batteries. There will be no need of getting rid of these batteries either or of remembering to recharge batteries periodically. In addition to this, with witricity, there is no need of plugging in any wires and plugs and thus face a mess of wires. How would be the future with Witricity? Modern science has now made it possible to use electricity without having to plug in any wires.

This concept is called witricty which seems to have a bright future in providing wireless electricity. [pic] [pic] Researchers developed witricity using resonance where energy is transmitted between two copper coils that resonate at the same frequency. Of these two coils, one is the power transmitter and the other, the receiver. The advantage of witricity is that there is no need of having a line of sight. As long as the object to be powered has a source of wireless power, in its vicinity, the appliance charges automatically without having to be plugged in.

Just imagine the future, with witricity, where there will be no need of power cables and batteries. The city just has to be covered with witricity hot spots wherein you can use your electric gadget battery and wire free making it more convenient to carry around and much lighter. With witricity, there will

be no need of charging batteries, or buying new batteries for your electrical gadgets. Just as beneficial witricity may be, there are some contraindications to the concept, with debates if it is risky living next to power lines and having a low power witricity network running in the home.

They wonder what happens if a glass of water is spilt in a witricity room. However despite these contraindications, witricity has a bright future with the many advantages it provides in terms of weight, convenience and portability of electrical appliances. CONCLUSION: The concept of Witricity is the most emerging one in the technical world. The desire of some scientists to see this world with out wires & cables made this concept came in to existence. With this Witricity all the electronic gadgets will charge themselves and tube lights, bulbs will glow themselves.

As the magnetic waves hardly and almost negligibly affect biological organisms, this concept of witricity will not be a hazardous for living beings including humans. So the usage of witricity will change this world more beautiful and easy. REFERENCES: • B. L. THERAJA & A. K. THERAJA, ‘ A TEXT BOOK OF ELECTRICAL TECHNOLOGY’, 1ST Edition, S. CHAND Publications, 1997. WEBSITES: ? htpp://web. mit. edu/newsoffice/2007/wireless-0607. html ? htpp://en. wikipedia. org/wiki/WiTricity ? htpp://www. cwanswers. com/8921/witricity