Volume: 3 Issue: 8 Pages: 01-04

Wireless Electricity and its Applications

[*1] Dr. Gajendra Singh Patel

[*1] Principal, The SICA Sr. Sec. School, Indore, Madhyapradesh, India.

Article Info.
E-ISSN: 2583-6528
Impact Factor (SJIF): 5.231
Peer Reviewed Journal
Available online:
www.alladvancejournal.com

Received: 10/July/2024
Accepted: 01/Aug/2024

***Corresponding Author**
Dr. Gajendra Singh Patel
Principal, The SICA Sr. Sec. School,
Indore, Madhyapradesh, India.

Abstract
Wireless electricity transmission is the transmission of electrical energy from a power source to an electrical load without using any wires. The wireless power transmission technology is widely used in the mobile, industrial and medical area. The technology of the wireless power transmission can eliminate the use of the wires and batteries. Thus it is so convenient and safe for all users. Wireless power transmission can be carried out by many methods, but the most common way seen was inductive coupling and resonant coupling which was recently developed. This paper involves the basic design of wireless power transmission. A wireless power system consists of a transmitter and a receiver. The primary coil and secondary coil are magnetically coupled when the two devices make contact and therefore the power transfer from the transmitter to the receiver. Test and analysis are done on how to develop the wireless electricity transmission through resonant coupling. In conclusion, wireless electricity has the potential to transform the way we power and recharge electronic devices. By eliminating the need for physical conductors, this technology can make charging more convenient and efficient for consumers, while also reducing the need for invasive procedures in medical devices.

Keywords: Wireless electricity, Transmitter, Receiver, Resonant coupling, Quality factor

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. Our forefathers marveled at the invention of glowing light bulbs by Thomas Edison 1879. However to us 21st centurions the light bulb is nothing out of the ordinary. When computers, cell phones, laptops, I pods etc were invented our antennas tweaked. Now this is what we call invention! However as times progressing we are getting used to these devices. In fact charging all these devices has become very cumbersome.

Each device has its own set of charge, with every family owning their cell phones the drawers are overflowing with all sorts of wires. How many times have you wished if there could be some way to do away with all the wiry clutter? When you are on the way to work and your cell phones beeps with hunger for a battery charge, haven't you wished your cell phone battery to get 'self-charged'? Well your plight has been heard by Witricity.

Witricity is nothing but wireless electricity. Transmission of electrical energy from one object to another without the use of wires is called as witricity. Witricity will ensure that cell phones, laptops, I pods and other power hungry devices get charged on their own, eliminating the need of plugging them in or even better because of witricity some of the devices won't require batteries to operate.

Principle

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 concept behind this fascinating term is a little complex however we can consider a simple setup understands the above.

Consider two self-resonating copper coils of same resonating frequency and identical diameter. One wire is connected to the power source while the other is connected to a device. The electric power from the source causes the copper coil to oscillate at a particular frequency. The space around the copper coil gets filled with non-magnetic radiations. This generated magnetic field further transfers the power to the

other copper coil. Since this coil is also of the same frequency, it starts oscillating at the same frequency as the first coil. This is known as coupled resonance and is the underlying principle behind Witricity.

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.

Concepts

The concepts governing wireless electricity is: SHARPNESS OF RESONANCE: Q-factor

The resonant frequency ω is determined by the inductance and the capacitance, but not resistance. The effect of resistance on electrical resonance is to make the 'sharpness' of the circuit response less pronounced. the sharpness of a resonance curve is usually expressed in terms of its resonance width-2Δω,which is the difference between two frequencies each of which corresponds to a current amplitude of $1/\sqrt{2}$ times the maximum current amplitude.

The Brain behind Witricity

This concept was first developed by Nikolas Tesla. Prof. Marin Soljacic from MIT is the one who has proved that magnetic coupled resonance can be utilized in order to transfer energy without wires. What's even more interesting is how he came about this idea. Soljacic, just like was fed up of his 'low battery 'beeping cell phone and wondered just like any of us if there was a way to get rid of this 'charging problem'. He remembered Michel Faraday's discovery of electromagnetic induction (1831) and used it to come up with witricity.

MIT' Experiment

In 2007, Marin Soljacic led a five member team of researchers at MIT and experimentally demonstrated transfer of electricity without the use of wires. These researchers were able to light a 60W bulb from a source placed seven feet away, with absolutely no physical contact between the bulb and the power. This technology consists of a witricity transmitter and another device called the receiver, which works like radio and mobile phone receivers where in the device, has to be in the range of transmitter. The first copper coil (24 inches in diameter) was connected to the power source and the second was connected to bulb, and were made to resonate at a frequency of 10 MHz the bulb glowed even when different objects (like a wooden panel) were placed between the two coils. The system worked with 40% efficiency and the power that wasn't utilized remained in the vicinity of the transmitter itself, and did not radiate to the surrounding environment.

Fig 1: Nicolas Tesla

Is Witricity A New Concept?

No, this concept of wireless electricity is not new. In fact it dates back to the 19th century, when Nikola Tesla used conduction–based systems instead of resonance magnetic fields to transfers wireless power. Further, in 2005, Dave Gerding coined the term Witricity which is being used by the MIT researchers today.

Why was this not Developed Before?

It is often said 'necessity is the best teacher 'and can be applied in this case as well. Only in this century, has the need for wireless electricity emerged so rapidly, spearheaded by agony caused by the cumbersome charging of endless devices. Earlier people didn't need it, so they didn't think about it.

With every family member owning gadgets like cell phones, I pods, laptops the number of wires are overloading. Here Witricity can play a significant role by reducing both the number of wires and simultaneously it can conserve the energy which is lost to overcome resistance offered in such wires.

Our Experiment

List of the Components of our Model

a) Coils: Two identical copper coils are of same diameter and same number of turns. These are required to produce oscillations and receive them. This is called resonant coupling.
b) Capacitors: Two identical capacitors with coil produces oscillations and same is received by another set.
c) DC motor: It acts as oscillator with coil, capacitor, and circuit.
d) DC battery
e) LED (light emitting diode): It shows received energy by glow.

Working of our Model

The coil and capacitor along with motor act as an oscillator. This produces oscillations due to charging-discharging of capacitor due to magnetizing and demagnetizing phenomenon of the coil. Frequency of oscillations is given by

$$\omega=1/\sqrt{LC}$$

Where L is the inductance of coil, C is the capacitance of capacitor. These oscillations are received by another resonant coil i.e. similar combination of coil and capacitor. Due to this energy is received the LED begins to glow.

In this manner electric energy is transmitted through resonant coils.

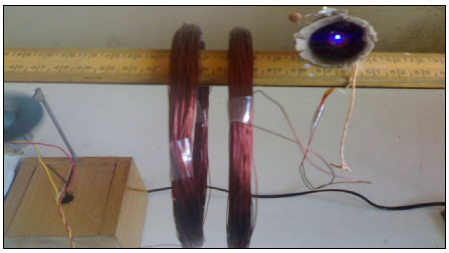

Fig 2: Our experiment

Is Witricity Technology Safe?

A Witricity's technology is a non-radioactive mode of energy transfer, relying instead on the magnetic near field. Magnetic

fields interact very weakly with biological organisms-people and animals-and are scientifically regarded to be safe. Witricity products are being designed to comply with applicable safety standards and regulations.

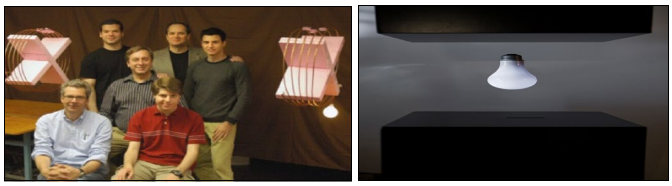

Fig 3: Researchers with Witricity

The transmission is not hindered by the presence of any object in the line of sight. If the object to be charged is in the vicinity of the witricity source, then the energy transfer will undoubtedly take place.

What is so Unique about Witricity

In this ‘ coupling resonance ‘ system the electric energy that is not used by the receiver does not get radiated into the surrounding environment but remains in the vicinity of the transmitter. This ensures safety as well as minimal wastage of power. One of the five researchers Dr. Aristeidis Karalis says that their coupling resonance system is one million times more efficient as compared to that of Nikolas Tesla.

Advantages of Witricity

Fig 4: Gadgets charger

More Convenient

- No manual recharging or changing batteries.
- Eliminate unsightly, unwieldy and costly power cords.

More Reliable

- Never run out of battery power.
- Reduce product failure rates by fixing the ‘weakest link': flexing wiring and mechanical interconnects.
- There is no need of having a line of sight.

More Environmentally Friendly

- Reduce use of disposable batteries.
- Use efficient electric ‘grid power' directly instead of inefficient battery charging.

Future Aspects of Witricity

Imagine a future where wireless electricity is the fact of standard. Imagine never having to break the walls to add another plug point. Heck, imagine a house without plug points. Your gadgets such as cell phones, media players, computers and other portable electronics will be capable of drawing power from the single electricity transmitter in your house.

Your flat screen TV, your touch screen wall will do the same, so will your fridge, your oven-somewhat like how your computer will access the internet wirelessly via Wi-Fi hub. Of course, present day gadgets are not yet equipped with witricity receivers but it’s only a matter of time.

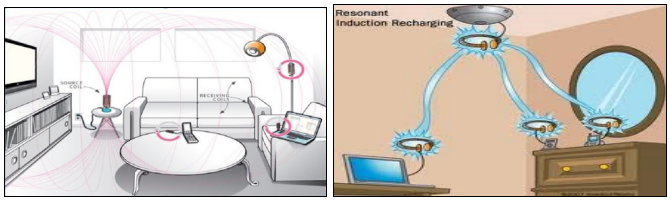

Fig 5: Gadgets equipped with witricity

Applications of Witricity

Earlier wireless electricity concept was present but its uses were very limited as it is truly said-necessity is the mother of invention. Fast pace of life, availability of electronic appliances and complex gadgets to every individual and every nook and corner of the world being connected to the main stream of life has made wireless electricity a more feasible idea.

Wireless Electricity Can Play a Pivotal Role in Many Spheres of Life, Such As

a) Our defense personnel have to stay in the rugged terrains of Leh and Ladakh were the electricity is available only when the climate permits. In such unfavorable conditions wireless can be a boon, for this eliminates the situation of hindrance caused by wires. With this their equipments can be easily charged.
b) It can be implemented for the purpose of charging car batteries, yo bikes etc. and can help to overcome fuel crisis to a certain extent.
c) Institutions like school and hospitals can maintain a chamber were all the required charging can be done without inerfering with other activties .
d) Many cases of accidents like blasting of mobiles etc. Can be avoided as wireless electricity is not hazardous.
e) If considered on large scale charging of different equipments individually would be less economical as compared to charging done collectively in a chamber.
f) Direct wireless power and communication interconnections at points of use in harsh environments (drilling, mining, underwater, etc.)… Where it is impractical or impossible to run wires.
g) Direct wireless power for wireless sensors and actuators, eliminating the need for expensive power wiring or battery replacement and disposal.
h) Automatic wireless charging for mobile robots, automatic guided vehicles, cordless tools and instruments… eliminating complex docking mechanisms, and labor intensive manual recharging and battery replacement.
i) Direct wireless power interconnections to replace costly vehicle wiring harnesses and slip rings.
j) Direct wireless powering and automatic wireless charging of smart cards.

Conclusion

Witricity’s technology is a non-radiative mode of energy transfer, relying instead on the magnetic near field. Magnetic fields interact very weakly with biological organisms-people and animals-and are scientifically regarded to be safe. Witricity products are being designed to comply with applicable safety standards and regulations. Hence witricity is technology safe. Witricity can transfer power depending upon the source and receivers. If it is relatively close to one

another, and can exceed 95%. Efficiency is primarily determined by the distance between the power source and capture device, however, the shape may impact the efficiency. It can transfer the power through walls also. Traditional magnetic induction requires that the power source and capture device be very close to one another usually within millimeters to transfer power efficiently. Witricity technology is based on sharply resonant strong coupling, and is able to transfer power efficiently even when the distances between the power source and capture device are several times the size of the devices themselves.

References

1. www.epaper.timesofindia.com
2. www.articlebase.com
3. Concepts of Physics by H.C. Verma
4. NCERT Physics
5. General Physics, Mechanics and Molecular Physics by Landau LD, Akhiezer AI, Lifshitz EM. Pergamon Press, 98-100.
6. Electronic Instruments and Systems by R.G.Gupta, Tata McGraw-Hill Publishing Company Limited, 143.
7. Physics for Degree Course, by Sharma RK, Shiksha Sahitya Prakashan, 199.
8. Physics for Degree students, by Arora CL, Chand S. Company Ltd. 152.
9. Unified Physics by Goyal RP, Shivlal Agrawal & Co, 117.
10. Concept of Physicsby Verma HC. Bharti Bhawan Publication, II, 316.
11. NCERT Physics. XII(I)7:177
12. New Simplified Physics, by Arora SL. Dhanpat Rai. XII(I):7.22
13. Cheon S, Kim YH, Kang SY, Lee ML, Lee JM, Zyung T. "Circuit-model-based analysis of a wireless energy-transfer system via coupled magnetic resonances", IEEE Trans. Ind. Electron., Jul. 2011; 58(7):2906-2914.
14. Fundamental Physics, Pradeep Publication India. XII(I):7/22