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Inductive Power Transmission

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Abstract
Technology trends are moving toward a completely wireless and mobile world, and our device chargers have followed suit. Inductive charging (wireless charging) may one day replace plugs and wires similar to how Bluetooth and Wi-Fi have modernized personal communication. The idea rets on inductive coupling that uses an electromagnetic field which transfers energy from the transmitter to the receiver. An alternating current passes through the coil in the charger, which engenders a fluctuating electromagnetic field. When the coil in the contrivance is placed inside this electromagnetic field, a current is induced in the coil, which then charges the contrivance's battery. This is why wireless charging is sometimes kenned as inductive charging.

Keywords: Wireless charging, Electromagnetism, Inductive coupling, Power transmitter.

1. Introduction
Wireless charging eliminates the cable typically required to charge mobile phones, cordless appliances and so on. Along a wireless charger, the battery within any battery-powered appliance can simply be charged by placing the appliance close to a wireless power transmitter or a given charging station. As an outcome of this, the device casing can be made totally sealed and also waterproof. Besides the inherent convenience it offers, wireless charging can also greatly enhance reliability, as the charging plug on the side of an appliance can be damaged easily, or by someone foolishly plugging in the wrong adapter. Thebasic foundation behind wireless charging is the famous Faraday's law of induced voltage, frequently used in motors and transformers. Furthermore, in 1891, Tesla exhibited wireless energy transmission through electrostatic induction using high tension induction coil before America Institute of Electrical Engineers at Columbia College [1]. Following in 1893, Tesla publicly demonstrates wireless power &proposes wireless transmission of signals in a meeting of National Electric Lights Association in St. Louis [2, 3].

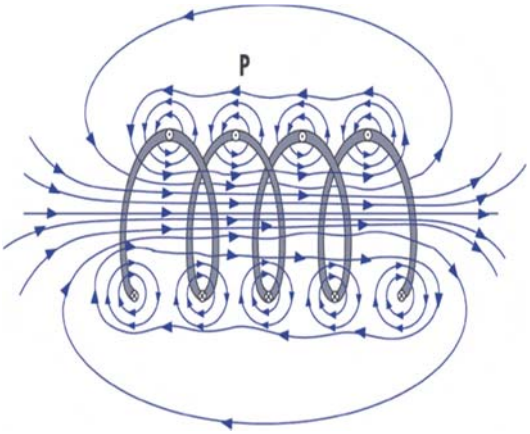

Fig 1: Current through coil.

2. Types of Inductive charging
Inductive charging is classified into inductive charging, radio charging and resonance charging. All wireless chargers are inductive charging with transmit and receive coils in close proximity. Radio charging serves low-power devices operating within a 10-meter (30 feet) radius from the transmitter to charge batteries in medical implants, entertainment devices and RFID chips.

A transmitter emits a low-wattage radio wave and the receiver converts the signal to energy. Radio charging offers high flexibility but has a low power capture and exposes people to electro-smog. Wireless charging required a international standard and the WPC (Wireless Power Consortium) completed this in 2008 by the introduction of the Qi norm. This unlocked the door for device makers to bid chargers for Qi-compatible devices with 5 watt of power; 10W is under process. Bigger batteries for the electric vehicles use resonance charging by making a coil "ring." The oscillating magnetic field always works under 1 meter of radius. To be in the power field, the distance between transmit and receive coil must be under the 1/4 wavelength. Resonance charging is not confined to high wattage wireless chargers., it is used at all power levels. Resonance charging is in experimental stages and no approved standards exist.

3. Working of Inductive charging

Without getting too technical, here are the fundamentals, wireless charging uses two coils of wire, one in the charger and one in the contrivance itself. It shares similarities with radio transmission transmitting power by *electro-magnetic fields*. It operates in a near field condition in which the primary coil produces a magnetic field that is picked up by the secondary coil in close proximity. Radio transmitter works on far field principle which sends waves that travel through the space. The receiving end of the wireless charger captures most of the energy generated, the receiving antenna of the radio only needs a few micro volts (one millionth of a volt) to recover a signal that becomes intelligent when amplified. In standby mode, the charging mat may send signals that sense an object. It detects using a change in capacitance or resonance. When something is detected then the mat transmits a burst signal, transferring enough energy to power up the receiving device. It responds by providing signal strength signals which can be used to improve the positioning of the receiver or to enhance magnetic coupling between mat and receiver. The charge mat only transmits power when a valid object is identified, which happens when the receiver fulfills the protocol as described by one of the interoperability standards. Upon full charge or when getting rid of the load, the mat switches to standby. Transmit and receive coils are safe gaurded to achieve good coupling and to lower stray radiation. Some charge mats use a free moving transmit coil that seeks the object placed above for perfect coupling, others systems feature different transmit coils by engaging only those in close proximity with the object.

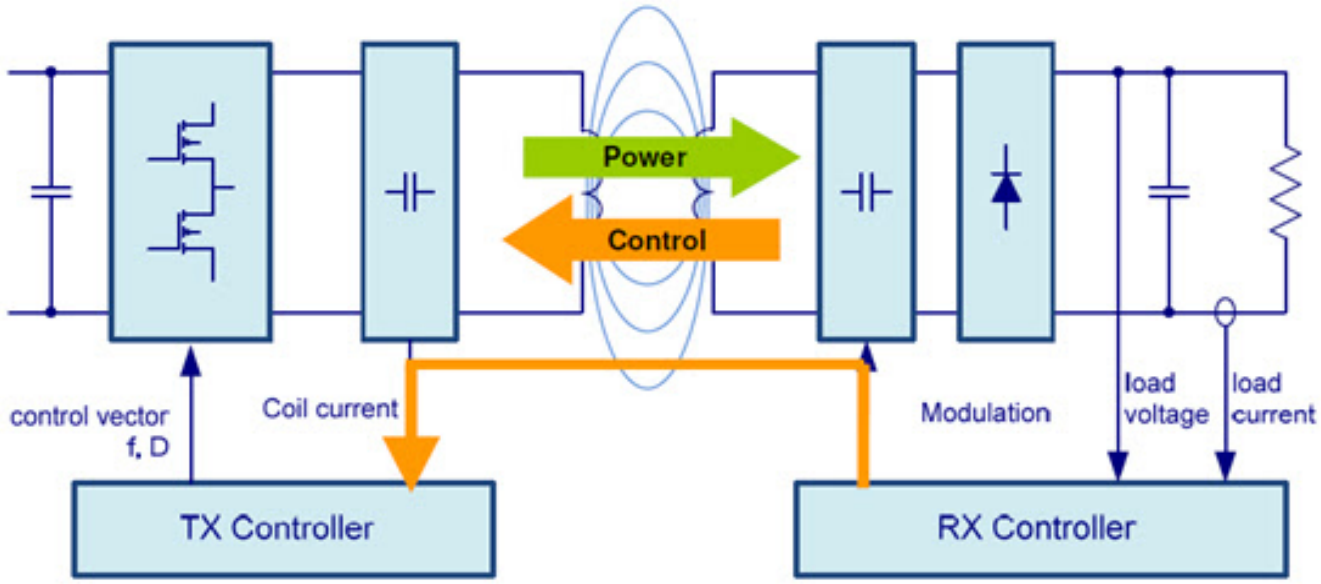

Fig 2: Wireless charging circuit system

4. Applications of Inductive charging

Smart Phones, Portable Media Players, Digital Cameras, Tablets and Wearables. Users are demanding for easy-to-use products, more freedom of positioning, and lesser charging times. Such applications normally requires 2 W to 15 W of power. Multi-standard interoperability is favored. Indcutive charging can coexist with NFC (Near Field Communication) and Bluetooth, which will give us very creative and innovative solutions. For example, paired phones can charge each other by placing them back to back. Basically, One person can charge another person's phone.

a. Accessories

Headsets, wireless speakers, mice, keyboards and many more applications can benefit from wireless power transmission. Plugging in the charging cables into the small connectors of always-shrinking devices is a burden to potent design. Eg. Bluetooth headsets need to be sweat-resistant to be able to work in a gym environment, only wireless charging can enable that.

b. Open Access Charging Point

Installing charging pads (transmitters) in the public domain requires systems to be risk-free and secure. But cagey charging systems can go well beyond stand-alone charging solutions. It can enable instant network-connectivity and create billable charging points if needed. Many coffee shops, airport lounge and hotels support these situations.

c. Computer Systems

Laptops, notebooks, ultra books and tablet PCs are all capable of wireless charging as either hosts or clients. The possibilities are infinite.

d. Automobile Applications

A wireless charger is perfect for mobile phone charging and suitable for placing them either on the dashboard of the car, without annoying wires going to the cigarette lighter socket. beside, since Bluetooth and Wi-fi require authentication to connect phones to car electronics, combining NFC with wireless charging can enable the user to charge the phone and also to automatically connect it to the car's Bluetooth and Wi-Fi networks without going through any explicit setup procedures.

e. Electric Automotive

Smart charging stations for electric vehicles are also arising, but needs much higher powers. Standards are under process.

f. Miscellaneous

Wireless chargers are finding its way into everything with a battery within it. That comprise gaming consoles and TV remotes, hearing aids, cordless vacuum cleaners, soap dispensers and even cardiac pacemakers. These are also capable of charging super capacitors (super caps), or any device that is traditionally powered by a low-voltage power cable.

5. Pros and cons

Wireless charging is very much convenient for users. It helps us to charge safely in a difficult environment where an electrical spark could cause an detonation; it allows charging where grease, dust and corrosion prevent a good electrical contact. Inductive charging is enduring and also does not harm the contacts on multiple insertions. State-of-the art wireless power transmission known as WPT combines the AC adapter which provides regulated DC and isolating the AC mains into a single power conversion. This amalgamation results in improved performance that is comparable with the Energy Star requirements. The Lost energy converts into heat and a wireless charger can get a bit heated while charging. If the generated heat is not properly controlled, the rise in the temperature causes stress to the battery and reduces its life. The heat rise only occurs during charging; the charging pad cools down once the battery is fully charged. WPC was very consious while releasing Qi. A medium-power version of up to 120 watts is in the works but before release, this norm must meet stringent radiation standard. Radiation prompts health concerns and these are shared with people living in the mid of cell phone towers and Wi-Fi stations. This could be at the center of the delay to develop the medium power standard, but interoperability and backwards compatibility to 5W systems also play a role. Electromagnetic energy from radio towers, mobile phones, Wi-Fi, and wireless charging, fall undernon-ionizing radiation and are believed to be causing no havoc. A large risk, if any, may be carrying a mobile phone close to the body. When any device is in standby mode, it is constantly seeking contact with a tower by transmitting signal busts. The transmit power is adjusted to the proximity to the tower and is greater in fringe areas. The wireless charging coils are absolutely sealed within the device, without any exterior electrical contacts, which means that they are totally protected. This is why inductive charging is often found in devices used in wet environments, like electric toothbrushes, where a standard charging socket would begin downsizing. The major drawback being that wireless charging is much less energy-efficient than wired charging due to the amount of heat the process generates. As a result, it takes more time to charge a device and if wireless charging really takes off, so many devices being charged every day won't be great for the environment.

6. Acknowledgement

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