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A review paper on Electricity Power Transferring and Charging through wireless

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Abstract- Wireless charging not only restricted ti ll voice transmission. It is an emerging and futur istic high demand technology. Thru wireless, till now we are transferring only text, images, and o ther information, but next would be the electricit y. Continuous use of the portable devices (i.e. mo bile and other hand hold device need power sour ce) have a power storage device/battery, that nee d to recharge again and again after it get discha rge or usages. In wireless charging technology p ower transmission done in an air gap. Charger a nd device don't have physical contact, but energy transmission is possible. Work is also going on, t o increase the operation time of per charging by developing a methodology to reduce the power c onsumption. The basic idea of this paper is to giv e a brief idea on wireless power transmission an d its future scope [1].

Keywords- Wireless Power Transmission, Energy transmission without physical contact, Inductive P ower Transfer.

I. INTRODUCTION

Wireless charging introduced near late 19th century, At that time Nikola Tesla (electricity pioneer) demonstrated a magnetic resonant coupling with the ability of transmitting electricity by creating a magnetic field through the air between two circuits, from a transmitter to a receiver.

Wireless charging is technique of transmitting the electric power with air gap / without physical contact from a charger to charge storage device. Theoretical idea and technology behind the wireless technology initially shared by the Nikola Teslain 1890s. Wireless power is commonly referred by the various names as Inductive Power Transfer, Inductive coupling, and Resonant Power Transfer [1]. Power transmission from power source to the load without any physical contact, essentially power transmission by maintaining an air gap.

Wireless charging about to making strong inroads in different field, in healthcare, in automotive and in other manufacturing industries. It offers dedication of increased mobility with advancement; devices/appliances receive power without any physical contact from a charger. Wireless power transfer is to become the most promising and prominent technology will impact on mainly automotive and mobile industries. In wireless power transfer we will make ourselves free from inconvenient wired charging methods.

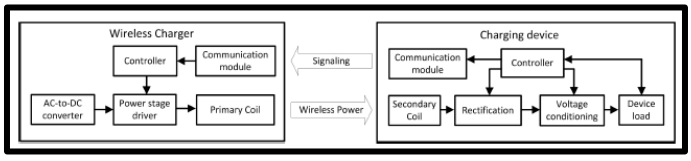

Figure1- Wireless power transfer model

II. WIRELESS POWER TRANSFER

Wireless power transfer involves transmission of power from transmitter to receiver with the help of oscillating magnetic field. Here, DC (Direct Current) provides by the power source and DC converted into AC (Alternating Current) with high frequency. AC energies the coil made by copper wire is work as a transmitter and responsible to generate the magnetic field. Receiver coil placed within the range of this magnetic field; an AC induced in this receiving coil.

Three techniques are used for wireless transmission [2],

a) Magnetic inductive coupling
b) Magnetic resonance coupling
c) Microwave radiation

Magnetic inductive coupling & Magnetic resonance coupling works on generated electromagnetic field near to the transmitter. Near field power is power is attenuated according to the cube of the reciprocal of the distance [2]. Microwave radiation can work for far field at a greater distance. For far field technique, radiation absorption does not make impact on the transmitter.

a) Magnetic inductive coupling- It is based on magnetic field induction that delivers electrical energy between two coils.

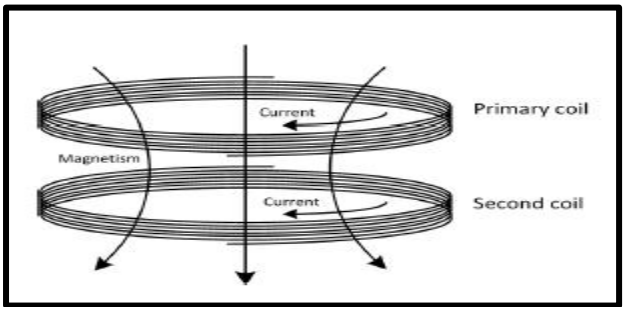

Figure2- Inductive Coupling

Above figure shows the reference model for the magnetic inductive coupling transmit the energy from primary coil to secondary coil, while primary coil generates predominant varying magnetic field to the secondary. It gives high efficiency and performance in close distance. It is very much popular now for mobile and smart watches charging.

b) Magnetic resonance coupling- It is work on the momentary wave coupling that is used to generates electrical power from one resonant coil to another resonant coil by oscillating magnetic field.

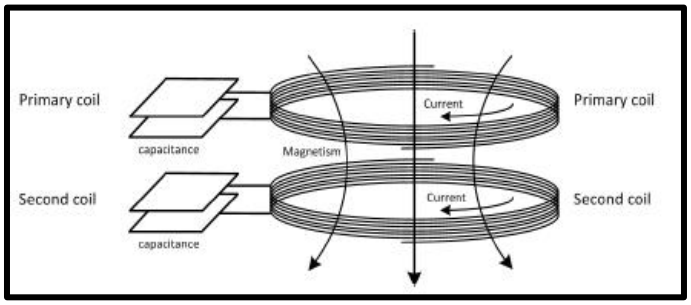

Figure3- Magnetic Resonance Coupling

As resonant coils, operating at the same resonant frequency, are strongly coupled, high energy transfer efficiency can be achieved with little leakage to non-resonant externalities [2]. This provides an advantage of protection to neighbouring atmosphere and transfer equipment. This technology looking good for long distance charging distance.

c)Microwave Radiation- It utilizes microwave as medium to carry electric energy. Microwaves travel through space at speed of light, usually in line of sight.

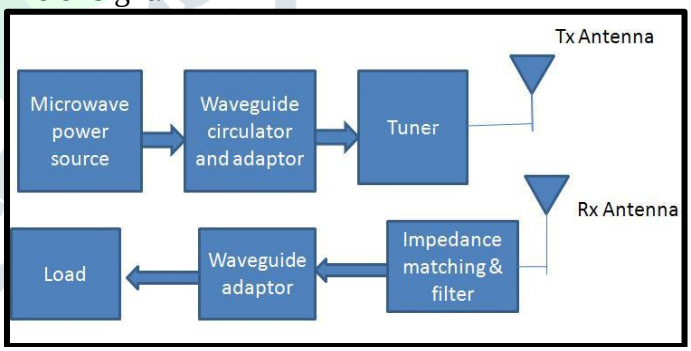

Figure4- Microwave Radiation

Power transmission begins with the conversion from AC to DC, followed by the conversion from DC to RF via the magnetron on the transmitter side. The captured microwaves propagate through thru air and are then converted to electricity by the receiver's rectenna. The typical frequency of microwaves ranges from 300MHz to 300GHz [2].Energy transfer can be done by other electromagnetic waves like infrared rays, X-rays, are not in use for security reasons.

Microwave energy can be emitted isotopically or in one direction by beam forming. The former is suitable for broadcast applications. In the case of point-to-point data transmission, beam forming transmits electromagnetic waves called power beam forming can improve power transmission efficiency. To generate the beam, we can use the antenna, for sharpness of the power beam forming can be improved by increasing the number of cameras.

III. COMPARISON AMONG DIFFERENT WIRELESS CHARGING METHODS.

For easy understanding we can understand it, with the table given below,

COMPARISON OF DIFFERENT WIRELESS CHARGING TECHNIQUES.

Wireless charging technique	Advantage	Disadvantage	Effective charging distance	Applications
Inductive coupling	Safe for human, simple implementation	Short charging distance, heating effect, Not suitable for mobile applications, needs tight alignment between chargers and charging devices	From a few millimeters to a few centimeters	Mobile electronics (e.g, smart phones and tablets), toothbrush, RFID tags, contactless smart cards
Magnetic resonance coupling	Loose alignment between chargers and charging devices, charging multiple devices simultaneously on different power, High charging efficiency, Non-line-of-sight charging	Not suitable for mobile applications, Limited charging distance, Complex implementation	From a few centimeters to a few meters	Mobile electronics, home appliances (e.g., TV and desktop), electric vehicle charging
Microwave radiation	Long effective charging distance, Suitable for mobile applications	Not safe when the RF density exposure is high, Low charging efficiency, Line-of-sight charging	Typically within several tens of meters, up to several kilometers	RFID cards, wireless sensors, implanted body devices, LEDs

Table 1

IV. HOW WIRELESS CHARGING WORKS

Wireless charging works on the inductive power transfer (IPT) or principles of magnetic resonance. Wireless charging also can call as inductive charging, by using an electromagnetic field to transmit (transfer) energy between chargers and charging devices via electromagnetic induction. This is traditionally done using a charging pad, also known as a charging station.

Energy is transmitted to the electronic device via inductively coupled, and the electronic device can use that energy to charge the battery of the electronic device.

The induction charger uses induction coil to generate an alternating current electromagnetic field from within the charging station, and the second induction coil in the portable device receives power from the electromagnetic field and converts it into an electric current to charge the battery. Two induction coils in proximity combine to form an electric transformer. Most wireless chargers only work over short distances and do not require physical contact between the device and its charging station, but the generated electric field is very weak, and the device needs to be in direct contact with the charging station [4].

V. INSIDE OF A WIRELESS CHARGER

A wireless charging contains a coil on its pad that is usually made from copper and is tightly wound. This is used as the medium to transfer the power out of this wireless charger. When a current is passed through the coil, it generates an alternating magnetic field. A smart phone capable of charging wirelessly has a copper coil receiver. This picks up the alternating magnetic field and induces a current which is then passed on through a power rectifier on to the battery of the smart phone to charge it [6].

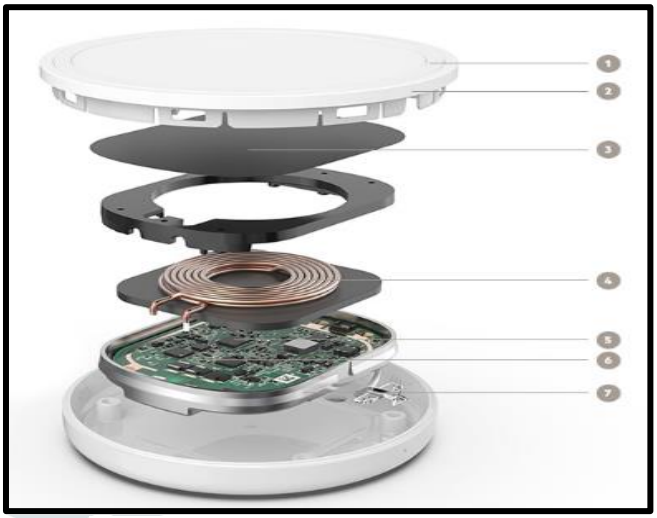

Figure5- Internal of wireless charger

1. Durable plastic cap with non-slip ring holds smart phone in place
2. Non-slip pad with polycarbonate base offers impact protection for durability
3. Unique e-shield further reduces interference of smart phone functions
4. Qi-certified dual-layer charging coil and extra-thick ferrite material deliver greater power and an increased charging area for easy alignment
5. Single chip solution provides universal compatibility to optimally charge devices at 5W, 7.5W, 9W and 10W
6. Thermal sensor regulates temperature for safe, efficient charging

7. Aluminium metal shield protects smart phone functionality for uninterrupted use while charging; battery life and critical phone functions are not disrupted

VI. CHALLENGES IN WIRELESS CHARGING

The idea of transmitting energy wirelessly was brought to TESLA in 1890. In the 19th century, there were many developments in mathematics and counterarguments about how electrical energy was transmitted [4]. Faraday's Law of Induction Explains Electromagnetic Force Ampere's circuit law states that electric current produces a magnetic field. It is guided to the conductor by the time-varying magnetic flux. The main challenges facing today's technology are:

Performance-One main reason why wireless charging is not fully integrated is that it is slower and less efficient than traditional chargers. The heat generated by some wireless charging technologies is usually higher than that of traditional charging technologies [4].

Mobility-This is called wireless technology, but in order to send a signal between the device and the charging station, the charging station must be mounted on the wall.

Expensive-Wireless charging technology is evolving day by day, adding complexity and manufacturing costs as both devices and chargers require drive electronics and coils.

Inconvenience-When you connect an electronic device to a wired charging device, you can move freely and use it while charging. But for most wireless charging, the device is

VII. ADVANTAGES & DISADVANTAGES

ADVANTAGES-

The connection is safe-there is no possibility of corrosion if all electronic devices are installed, away from atmospheric water and oxygen.

Low Infection Risk- There is no stress of electrical failure such as short circuit due to poor insulation, mainly when connections are frequently formed or disconnected [6].

The risk of infection is low-for embedded medical devices, the transfer of electricity through a magnetic field through the skin ignores the risk of infection associated with the wires entering the skin. **Durability**-The device does not need to be plugged in and out frequently, basically reducing wear on the device's socket and connecting cables. Improved convenience and aesthetic quality-Avoid cables.

DISADVANTAGES-

Slow Charging Speed – Due to its low efficiency, it takes longer to charge the device, even with the same amount of power.

Expensive – Wireless charging requires drive electronics and coils for both the device and the charger, increasing manufacturing complexity and cost.

Create discomfort – Cable the electronic device to allow it to move around and move freely while charging. In most implementations of wireless charging, electronic devices. It must be placed on the pad to charge, so it is not easy to operate while charging.

New technology reduces transmission losses due to ultra-thin coils, high frequencies, and optimized drive electronics. For this reason, more efficient and compact chargers and receivers offer integration into mobile phones and batteries with fewer changes. These technologies offer longer charging times than wired technologies and are always looking for ways to mobile devices [4].

VIII. CONCLUSION

Wireless charging technology gives the possibility of eliminating the last remaining wired connection required to charge portable electronic devices. This amazing technology has made great strides over the last few decades, resulting in a huge number of user-friendly applications.

Broadly explain about the charging methodology, working principle, internal parts details of a wireless charger and about advantages and disadvantages of wireless charging. We also try to explain about the future scope and before use of the wireless charger what we should know.

IX. FUTURE SCOPE

Technology has reached new heights of the modern world. Scientific research helps develop techniques for user-friendly use. Wireless charging also has potential in the future and has potential for significant growth. The new approach reduces transfer losses by using ultra-thin coils, high frequencies and optimized electronics. This

makes the equipment highly efficient and compact.

Some companies have already designed a system where the wireless charging platform in a hotel room can not only charge the phone, but also detect who is in the room [4].

Medical devices and equipment- Inductive charging plays a very important role in medicine and the future of medicine. Today, even the most basic medical procedures require an advanced range of medical devices. An appliance that operates primarily through a battery pack or mains power. Wireless charging helps reduce sources of pollution,

Minimize physical hazard [4].

Vehicle-Wireless charging of electric vehicles is one of the most studied wireless power transfers. Wireless charging allows you to charge your parked or moving vehicle, providing a convenient charging experience for your users [4].

X. WHAT WE NEED TO KNOW ABOUT WIRELESS CHARGING

1) What is wireless phone charging? Wireless charging allows you to charge your smart phone's battery without cables or plugs.
2) How does it work? Inside the smart phone is a copper receiver induction coil. The wireless charger has a copper transmit coil. When the device on the charger, the coil in the transmitter creates an electromagnetic field and the receiver converts it into electricity for the phone's battery. This process is known as electromagnetic induction **[7]**.
3) What's 'Qi' wireless charging? Qi (pronounced "chi", the Chinese word for "energy flow") is a wireless charging standard adopted by the largest and most well-known technology makers such as Apple and Samsung **[7]**.
4) Is wireless charging faster than wired charging? No way, wireless charging is slower than the wired charging.
5) How far away can the phone be when using a wireless charger? On the top of the charger pad.
6) Is wireless charging bad for my phone battery? All rechargeable batteries begin to degrade after a certain number of charge cycles **[7].**
7) Can wireless charging overcharge my phone battery? You can't overcharge a smart phone battery, but keeping it charged to 100% **[7]**.
8) Should I leave my phone on the wireless charger overnight? Smartphone's are built to prevent their batteries from being overloaded. If you leave your phone to charge overnight, it will reach 100% capacity then stop, although it will continue to top up the battery every time it falls to 99% **[7]**.
9) Do wireless chargers work when the phone has a case? Some phone cases (such as wallet cases) might be too thick for wireless charging to work properly. Cases made of plastic, silicone; rubber and leather don't seem to affect wireless charging too much **[7]**.
10) Can I use a wireless phone charger in the car? Nee to install a wireless charger in car.
11) Can I charge more than one phone at the same time? It's depending on the design of the charger.
12) What are the pros and cons of wireless charging?

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