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Wireless EV Charging Station

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***Abstract*— Electric appliances is a candidate to be the future of world transportation. The idea of changing fuel charged transportation services to electrically charged systems is a breakthrough for efficient energy harnessing, conservation, and smooth energy transformation. Also, it is an effort to reduce detrimental emissions which have corresponding ramifications on a global scale. The objective of this project is to design and construct a method to transmit wireless electrical power through space and charge a designated low power device. The system will work by using resonant coils to transmit power from an AC line to a resistive load. Investigation of various geometrical and physical form factors evaluatedin order to increase coupling between transmitter and receiver.**
A success in doing so would eliminate the use of cables in the charging process thus making it simpler and easier to charge a low power device. It would also ensure the safety of the device since it would eliminate the risk of shortcircuit.

Keywords— Wireless EV, Charging station, Wireless network, charging

I. INTRODUCTION

We live in a world of technological advancement. New technologies emerge each and every day to make our life simpler. Despite all these, we still rely on the classical and conventional wire system to charge our everyday use low power devices such as mobile phones, digital camera etc. and even mid power devices such as laptops. The conventional wire system creates a mess when it comes to charging several devices simultaneously. It also takes up a lot of electric sockets and not to mention the fact that each device has its own design for the charging port. At this point a question might arise. —What if a single device can be used to charge these devices simultaneously without the use of wires and not creating a mess in the process? We gave it a thought and came up with an idea. The solution to all these dilemma lies with inductive coupling, a simple and effective way of transferring power wirelessly.

Wireless Power Transmission (WPT) is the efficient transmission of electric power from one point to another trough vacuum or an atmosphere without the use of wire or any other substance. This can be used for applications where either an instantaneous amount or a continuous delivery of energy is needed, but where conventional wires are unaffordable, inconvenient, expensive, hazardous, unwanted or impossible. The power can be transmitted using Inductive coupling for short range, Resonant Induction for mid-range and Electromagnetic wave power transfer for high range. WPT is a technology that can transport power to locations, which are otherwise not possible or impractical to reach. Charging low power devices and eventually mid power devices by means of inductive coupling could be the next big thing.

The objective of this project is to design and construct a method to transmit wireless electrical power through space and charge a designated low power device. The system will work by using resonant coils to transmit power from an AC line to a resistive load. Investigation of various geometrical and physical form factors evaluated in order to increase coupling between transmitter and receiver.

A success in doing so would eliminate the use of cables in the charging process thus making it simpler and easier to charge a low power device. It would also ensure the safety of the device since it would eliminate the risk of short circuit.

The objective also includes the prospect of charging multiple low power devices simultaneously using a single source which would use a single power outlet.

II. LITERATURE REVIEW

Nowadays Mobile communication not only restricted for voice transmission but also used for various multimedia applications like transfer of text, images, videos, playing games etc. Continuous use of mobile phones needs charging of the batteries again and again. Imagine a system where your cellular phone battery is always charged, You don't have to worry if you forget the charger. In this paper two methods are studied first is wireless charging of mobile phones using microwaves which eliminates the need of separate charger for mobiles .In this method the charging of mobile phones is done using microwaves when we talk on that particular mobile .The microwave frequency used is 2.45Ghz.The second method is charging of mobile phones using Bluetooth.

Keywords— Mobile communication, wireless charging

There is an abundance of energy around us at all times. Radio and television towers, the cellular phone antennas, and even satellites orbiting earth are constantly transmitting energy. It will be very useful if we gather the energy and store it and use it as a source of power for other circuits. In the case of the cellular phone, this power could be used to recharge a battery that is constantly being depleted. The first step is to capture the energy from air and second step needs an efficient antenna which will convert AC to DC. [1]

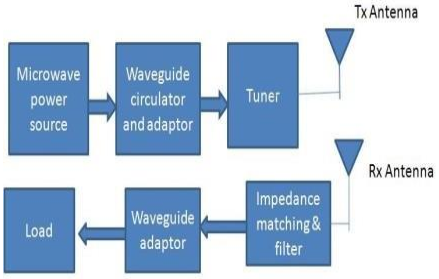
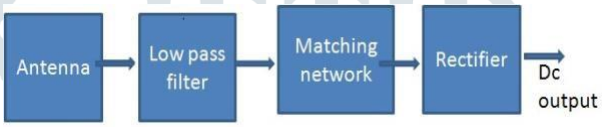


Figure 1. Block diagram of Wireless transmission

1.1 Wireless charging of mobile phones using microwaves [2]

Microwaves are a form of electromagnetic radiation with wavelengths ranging from as long as one meter to as short as one millimetre, or equivalently, with frequencies between 300 MHz (0.3 GHz) and 300 GHz. There are various advantages of microwave over low frequencies such as –

- Directivity: As frequency increases the directivity increase and beam width reduces.
- More bandwidth at higher frequencies.
- Microwave signals travel by line of sight and are capable of freely propagating through snow, clouds and smoke therefore used for communication. [3] The block diagram consists of microwave generator which actually produces microwave and microwave convertor which will convert microwave energy into dc power



1.2.1 Microwave generator.

Magnetron is used to generate microwave at preferred frequency; basically the magnetron is a high powered vacuum tube that works as self-excited microwave oscillator. To produce high power output crossed electronic and magnetic fields are used.
A circulator is a passive device which has three or four ports in which a radiofrequency or microwave signal entering any port is transmitted to the next port in rotation. A port in this context is a point where an external transmission line or waveguide connects to the device. For a circulatorapplied to port 1 only comes out2 only comes out of port 3; a comes out of port 1.

Class	Maximumpower	Range
Class1	100mw	100 meters
Class 2	2.5 mw	10 meters
Class 3	1 mw	1 meter

which has four ports, a signal of port 2; a signal applied to port signal applied to port 3 only

Tuner is used for impedance matching with transmitting antenna. The transmitting antenna can be a patch antenna and is fabricated from copper plating that is soldered to a feed wire and has a ground plane. We can use slotted waveguide antenna for the same purpose. which has four ports, a signal of port 2; a signal applied to portsignal applied to port 3 only
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1.2.1 Microwave convertor:

Rectenna is used to convert microwave energy into dc power. A simple rectenna element consists of a dipole antenna with an RF diode connected across the dipole elements. The diode rectifies the AC current induced in the antenna by the microwaves. Schottky diodes are used for production of DC power, which powers a load connected across the diode. Schottky diodes are usually used because they have the lowest voltage drop, highest speed and low noise index which is important for communication receivers. **"**Rectenna" is key component in wireless power transmission because the capacity of the utility power at the receiving site depends on the rectenna performance.

2. Block diagram of convertor system

Antenna shown here is rectangular microstrip patch antenna (RMPA).Rectification process converts ac to dc. Low pass filter is used to remove the harmonics which are generated during rectification process it is necessary to remove the harmonics as they are radiated back through antenna thus resulting in significant loss of energy. To suppress re-radiation and to maximize the power conversion, Low pass filter is placed between antenna and rectifier setup. The cut-off frequency for Low Pass Filter has been selected such that second harmonic signals are rejected. [4].The use of matching network is impedance matching of input impedance of low pass filter and antenna so that maximum power will be transmitted. After this match circuit the rectifying diode is placed for rectification followed by DC pass filter which consists of smoothing capacitor for reducing ripples also followed by load. The conversion efficiency depends on this DC pass filter set up i.e. value and position of dc pass filter setup.

1.2.2 **Frequency to voltage convertor.** A signal is sent when user is talking this is very important as phone has to be charged as long as user is talking. The frequency to voltage convertor would act as switch to turn rectenna circuit ON when user starts his conversation signal is sent to sensor circuit. LM 2907 can be used as a sensor to convert frequency to voltage. Thus on reception of the signal sensor circuit switches rectenna circuit ON and mobile phone begins to charge.

2. Advantages.

The charging of mobile phones is done wirelessly so eliminates the need to use separate charger and plugs. The time required to charge the mobiles can be saved. Wastage of power is less.

3.Limitations:

- Radiation problem may accure.
- Network traffic may cause problem in charging.
- Rectenna circuit makes device bulky.
- Wireless charging increases heat in device as compare to wired method.

4. Charging of mobile phones using Bluetooth [5].

Bluetooth is a wireless technology standard for exchanging data over short distance using short wavelength microwave transmission in the ism band from (2400-2800) MHz, from fixed and mobile devices. The table shows different classes of Bluetooth based on maximum power it can transmit.

Different classes of Bluetooth

Bluetooth can act as transmitter as well as receiver. Thus Bluetooth device can be used for wireless charging of mobiles. Transmitter is one Bluetooth device which will transmit RF signals of different power depending upon its class. Receiver will be another Bluetooth device and from received signal maximum energy will be extracted using following voltage doubler circuit.

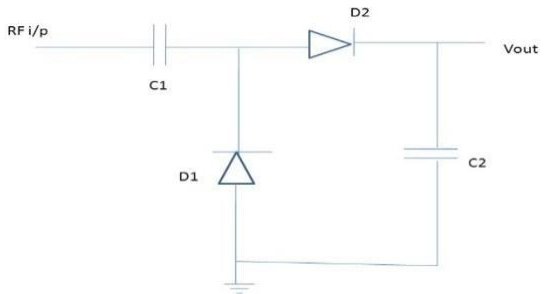

Figure 3 Voltage doubler circuit

A voltage doubler is an electronic circuit which charges capacitors from the input voltage and switches these charges in such a way that, in the ideal case, exactly twice the voltage is produced at the output as at its input. The simplest of these circuits are a form of rectifier which take an AC voltage as input and output a doubled DC voltage. The output of this circuit is used to charge the mobile batteries.

Application:

This method can be use to charge the mobile phones in case of emergency, as the circuit size is small it can be easily implemented inside the mobile phones.

Conclusion:

In this paper two methods for wireless charging of mobile phones are studied. Charging of mobile phones can be done using microwaves and Bluetooth. These methods eliminate need of separate charger thus making the use of mobiles possible in case of emergency even if charger is not available. These methods also results in harvesting of energy.

Mobile charging stations (MCS) in the state-of-the-art literature and in practice are studied. This paper also addressed various research aspects of MCS such as their benefits to EV owners and power grid, their challenges, and open research topics for future research. It concludes that further investigations are required in this research area. These research areas include, but are not limited to, optimal coordination between different charging methods including MCS, mitigation of adverse impacts of high EV penetrations on power grids through MCS, and impacts of MCS on market penetration of EVs. This paper serves as a step to understand the state-of-theart in the area of MCS and as a foundations for new approaches for MCS to make EV charging as convenient and fast as filling up ICEV tanks with gas.

VII. Future Scope

To transmit the power to a greater distance, a high-power radio frequency amplifier connected with an oscillator is needed. But the construction of the bulky RF power amplifier requires much time and patience.

High power vacuum tube transistor amplifier with high current will make the system more efficient.

A crystal oscillator circuit might be a better option for the transmitter circuit since it can produce a very high frequency A.C. current.

Further effort on this same project can yield some real solutions that can solve the problems of this project. The knowledge of this project will help those who want to design a wireless charging system.

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