Wireless Charging Using Microwaves

Benazir begum
Electronics and communication Engineering
Idhaya Engineering College for women

Sivaranjani
Electronics and communication Engineering
Idhaya Engineering College for women

In today's fast moving world, cell phones have become inseparable part of life. Charging of cell phone is always been a problem for the users. It is a mammoth task to charge the battery after a while, especially when there is no power outlet around us. It is a major problem in today's electronic gadgets. Although the world is leading with the advancements in science and technology, this technology has some shortcomings. This wireless charging technology is expected to eliminate all the hassles with today's battery charging problem. The advantage of presented technology is that it can wirelessly charge up the battery which can save time, electricity and money in a long run for the general public. It is prototype device that converts microwave signals to DC power. Today's present day world requires the complete and advanced technology and for this purpose we are proposing -"Wireless Charging of Mobile Phones Using Microwaves".

Index Terms:

Rectenna, MPT (Microwave Power Transmission), WPT (Wireless Power Transmission), Magnetron, Nikola Tesla, William.C.Brown.

I.INTRODUCTION:

This 21st century as people call it is the era of smart phones and technology. Technological advancements have taken giant strides to make the life a common man simpler and efficient. But one area of problem for our day to day smart phones usage and activities is the battery. Since carrying a charger around us wherever we go becomes inconvenient, the question arises-What if our phone could charge itself when we want it to be charged wirelessly? The answer is Wireless Power Transmission. Microwaves are electromagnetic waves with wavelengths ranging from as long as one meter to as short as one millimeter. The prefix "micro-" in "microwave" is not meant

to suggest a wavelength in themicrometer range, it indicates that microwaves are "small" as compared to the waves used in typical radio broadcasting; in that case they have shorter wavelengths. Wireless Power Transfer (WPT) is the transmission of electrical power from a power source to a consuming device without using solid wires or conductors. In simple terms, the electrical power will be transmitted to the target device using electromagnetic waves such as microwaves. Nikola Tesla, in late 1800's coined and introduced us to the world of wireless transmission which was later researched uponby William.C.Brown who pioneered the technology to transmit power using microwaves giving rise to the term Microwave Power Transmission (MPT)[1]. Although introduced in 1964, this technology remains an area of interest for researchers and engineers all over the world, even to this day. Successful implementations of MPT have been done over the world in Japan; MIT where a research team led by Professor Marin Soljacic successfully transmitted power to a 60W light bulb at 40% efficiency over a distance of 2m (7 feet). With this paper, our aim is to provide certain future techniques which can be efficiently applied to the world of smart phones and technology to avoid the mess of using wires and chargers as a whole to make the life of a common human being easy.[1]

II. METHODS:

The microwave signal is transmitted from the transmitter along with the message signal using special kind of antennas called slotted wave guide antenna at a frequency of 2.45 GHz.[5]

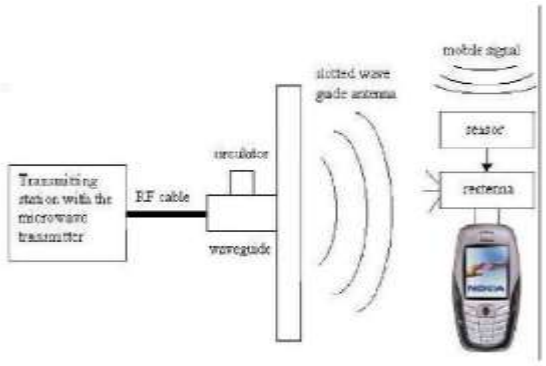

Fig 1: Basic block diagram of wireless transmission of microwaves.

The microwave signal is transmitted along with message signal using slotted wave guide antenna. The sensor search for the mobile signal, in addition it has a "RECTENNA". Rectenna receives the transmitted power and converts the microwave power to DC power.[2]

III. WORKING:

A wireless charger sends an AC power signal to the transmitting coil. When the current is transferred through the coil an electromagnetic field is created around the coils, which when in range of another induction coil, the oscillating magnetic field creates a current in the receiving coil. Power can be transferred safely through objects which exist between the magnetic field creating coils. The addition of extra coils extends the range at which the power can be inductively transferred. Wired circuitry on the receiver converts the AC power signal into DC voltage which can then be used to charge electronic devices through batteries. It is this exact method used for charging pads and industrial wireless solutions.

IV. TRANSMITTER DESIGN:

It is a self-contained microwave oscillator that operates different from linear oscillator. A magnetron consists of a short copper cylinder with a number of cavities that open into a central vacuum chamber containing a metal cathode. A permanent magnet provides a magnetic field that runs parallel to the axis of the cylinder.[3] The cathode is then heated up by a high voltage direct current, causing it to produce electrons streaming out towards the cylinder wall orthogonally to the magnetic field. The electrons are then deflected by the field into curved paths, causing them to set up circular

currents within the cavities. These currents produce microwave radiation at frequencies that are related to the size of the cavities.[3] The microwavesare then directed to towards the mobile device waiting for its reception so as to be converted back to the electrical power through rectenna. In the case of a magnetron used for radar and communication, the waveguide will connect to an antenna that transmits the waves.This is achieved by a metal structure known as a waveguide, along which the waves travel; normally a slotted wave guide antenna is used. It normally extends outside the main body from one of the cavities, capturing the microwaves and guiding them along its length.[3] Cross field and magnetic field are used to produce highpower output. The slotted wave guide antenna is used to transmit the microwave generated at the transmitter side with the help of magnetron. This antenna has aperture efficiency up to 95 percent making it an almost ideal power transmitter. This particular antenna has a very high power handling capacity with 64 slots

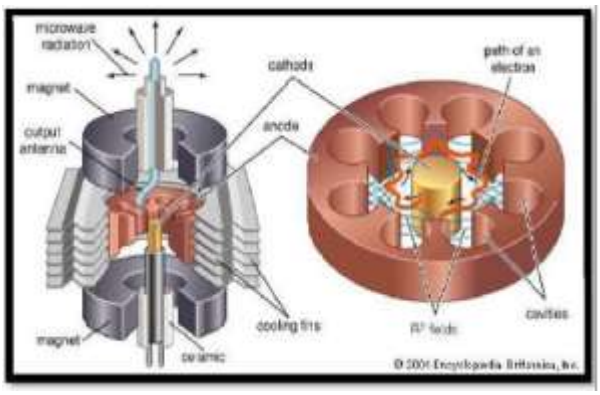

Fig 2: Magnetron used in wireless transmission of microwaves.[4]

V. RECEIVER DESIGN:

The basic addition to a mobile phone is rectenna.Its elements are usually arranged in a mesh pattern as shown below in Fig 3. A simple rectenna is constructed by using a schottky diode which is formed by fusing a metal with a semiconductor. The semiconductor material used for this purpose is selected from different materials like chromium, molybdenum, tungsten etc.[2] The schottky diode is used in this antenna receiver design because its recovery time is faster, it has a comparatively lower forward voltage drop and pretty good RF characteristics. The following diagram shows an array of rectennas connected together to power a large solar satellite. The antenna which is used in the rectenna can be Yagi-Uda, patch, dipole or parabolic dish antenna.[1]

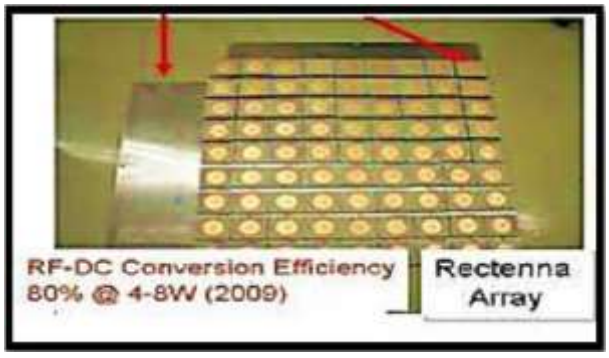

Fig 3: Rectenna which is fitted on the cell phone for reception of microwaves.[4]

VI. RECTENNA:

Rectenna is a combination of a rectifier and an antenna. The dc electrical power for charging the mobile phone is transmitted from the tower in the form of microwaves. At the receiver end, Rectenna which is fitted

on the mobile circuitry converts it back to the electrical power and the mobile gets charged.[2] Rectifying antenna rectifies the received microwave signal energy into the dc current. It comprises of a mesh of dipoles and diodes for rectifying purpose. A simple rectenna can be constructed by using a schottky diode which is going to be placed in between the antenna dipoles. The diode rectifies the current induced in the antenna by the microwave energy.[2] The following figure gives us the idea about construction of rectenna using a schottky diode.

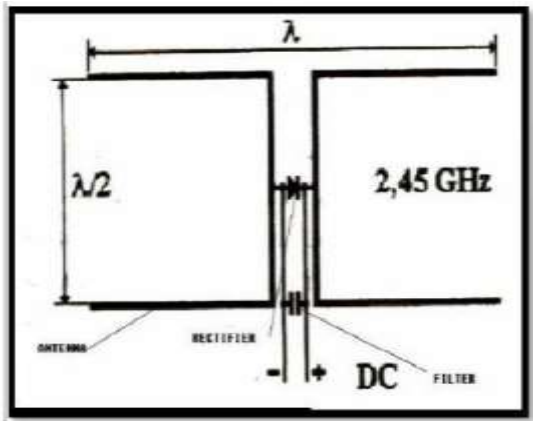

Fig 4:Concept of rectifying antenna.[4]

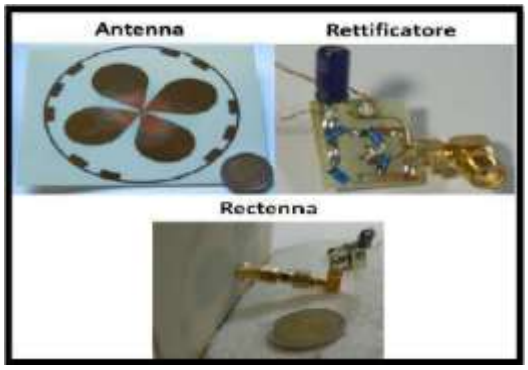

Fig 5: Rectenna.[5]

VII. SENSOR CIRCUITRY:

It is a simple sensing circuit using, which detects whether the message signal is received or not. A simple F to V converter such as LM2907 would greatly serve the purpose. It would simply act as a triggering switch for the rectenna. Thus on receiving the message signal the sensor circuit will trigger the rectenna to be switched ON and vice versa.[5] The following is the block diagram for LM2907 as sensor circuitry.

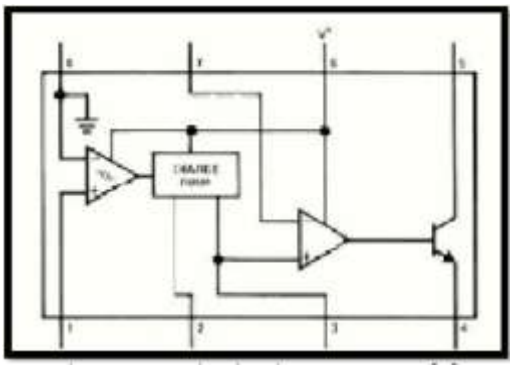

Fig 6: Sensor circuit using IC LM2907.[4]

VIII.CONCLUSION AND FUTURESCOPE:

The presented paper successfully explains the novel method of charging the mobile phones with the use of microwave power without using wired chargers. Since, it is a wireless technique this technology can be implemented even in remote areas devoid of charging facilities. The limitations of MPT can be overcome with time and more research to increase the the distance of power transmission, its biological and global effects thus making its future prospects bright for researchers and students all of the world. A new milestone in the revolution of mobile phone technology will be achieved by novel use of RECTENNA AND SENSOR. As Dr Neville of NASA stated "You don't need cables, pipes or copper wires to receive power. We can send it to you like a cell phone call- where you want it, when you want it, in real time." We hope for a future like that.

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