TRANSACTIONS ON ELECTROMAGNETIC SPECTRUM

A General Survey on the Wireless Power Transfer

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Abstract: In recent years, wireless power transfer has been popular as an alternative technique for the powering of the wireless networks, small scale electronic devices and low power elements. The major advantage of the wireless energy transfer is that it cancels the replenishment of the batteries periodically. In this paper, the general types of the wireless power transfer systems are presented. In addition to this, system components of the energy harvesting, techniques used and applications are presented.

Keywords: Wireless power transfer, Inductive Coupling, Magnetic Resonance Coupling, Microwave Power Transfer

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1. INTRODUCTION

In the last decades, the wireless power transfer became an important subject with the increasing of the portable and wearable systems which modifies our lives forever for the better [1]. Because wireless power transfer mainly eliminates the cables of these devices which one decreases the ease of use and comfort [2].

In addition to this, in some special applications where energy cannot be transmitted by cable, the use of wireless power transfer becomes mandatory. For instance, implanted biomedical devices and wireless sensor networks can be given to the applications. On the other hand, the devices to b energized may also be in a position that cannot be physically reached.

At the beginning of the 1900's the first application of the wireless power transfer was tried as the studies of Nicola Tesla [3]. Since then, many applications and methods are developed and given in the literature. In this paper, the general information about the wireless power transfer systems based on various physical principles such as radio frequency or microwave power transfer, inductive coupling and magnetic resonance coupling is presented [4-6].

2. THE TYPES OF THE WIRELESS POWER TRANSFER

The wireless power transfer mainly consists of three main systems which are the inductive coupling, magnetic resonance coupling and radio frequency energy transfer which one also can be stated as a far-field energy transfer technique.

2.1. Inductive Coupling

A wireless power transmission system with inductive coupling operates based on Ampere's circuit law and Faraday's law of induction. The Ampere the explains the relationship between the magnetic field and current in the coil system [7].

In addition to this, Faraday laws defines the relationship between a time-varying magnetic field and an induced electric field. In the inductive coupling power transmission, the energy is transferred with the help of the magnetic field between the coils [8]. The system efficiency of the inductive coupling mainly belongs to the coupling coefficient, which one changes with the distance between the coils.

As a result of this, it can be concluded that the energy cannot be transferred to the long distances with the inductive coupling power transmission since the efficiency of the system decreases with the distance of the coils. The general topology of the inductive coupling wireless power transfer is given in Figure 1.

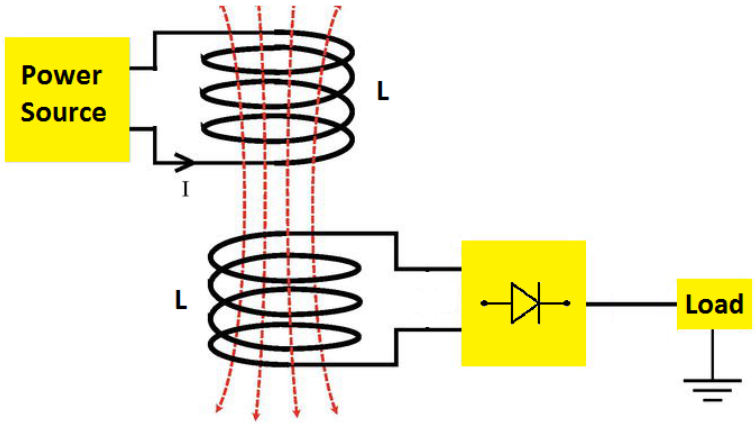

Figure 1. The topology of the inductive coupling wireless power transfer

2.2. Magnetic Resonance Coupling

This magnetic resonance coupling is obtained by joining the capacitance (C) with the induction (L) coil, since this connection produces the resonance circuit. The power flow from one resonator to the other one is provided electromagnetically [9]. The general topology of the magnetic resonance coupling wireless power transfer is given in Figure 2.

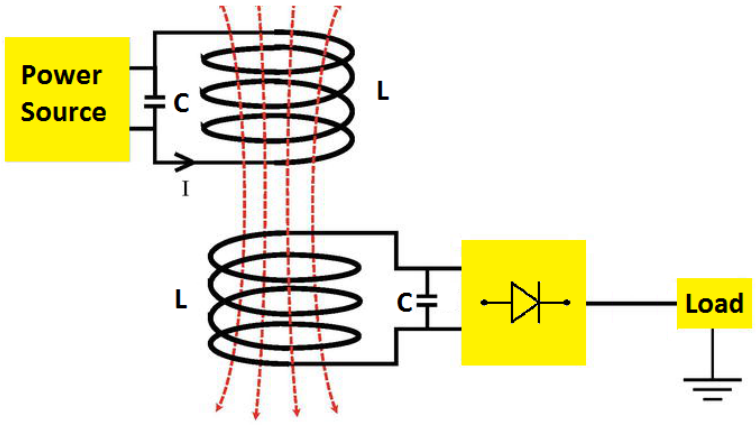

Figure 2. The topology of the magnetic resonance coupling wireless power transfer

2.3. Microwave Power Transfer

The microwave or radio frequency power transfer became an important subject in the last decades which means that converting the electromagnetic wave power to the usable electricity. The electromagnetic signal range used for the radio frequency energy harvesting in other words the frequency range of the wireless power transfer changes from 3 KHz to 300 GHz [10]. It is clearly seen that it has a very extensive wideband. So the scientists have different frequency band possibilities they can use.

The radio frequency energy harvesting is the more eligible for the devices which are located and distributed to the far filed zone [11]. The power level of the radio frequency waves in the ambient environment is quite low, since the waves are attenuated depending on the distance between the system elements. The general topology of the microwave power transfer is given in Figure 3.

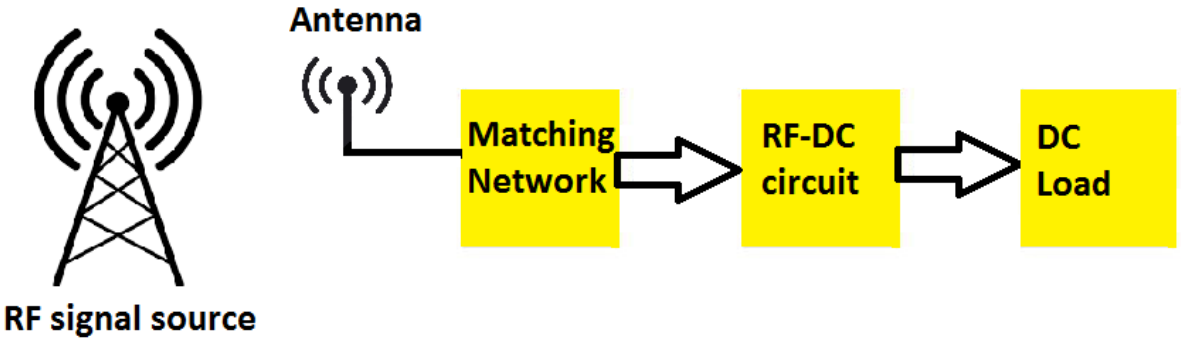

Figure 3. The topology of the RF energy harvesting

3. CONCLUSION

In the last decades, the wireless power transfer became an important subject with the increasing of the portable and wearable systems which modifies our lives forever for the better. In this study, it was aimed to provide information about the wireless power transmission systems which can be used for increasing our lives comfort. In addition to this, the types of the wireless power transfer are given to the readers.

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