UNIVERSITI TEKNOLOGI MARA

A NEW SUPERIMPOSED TOPOLOGY FOR SINGLE PHASE WIRELESS POWER TRANSFER

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ABSTRACT

Wireless Power Transfer (WPT) is a process of transferring electrical energy without using any physical wire or cable. There are two popular methods in WPT system which are Capacitive Power Transfer (CPT) and Inductive Power Transfer (IPT). The main problem in the WPT is to produce high power in a long distance. There are studies that achieved power tansmission of more than 2 meters and power transfer of high voltage more than 1kV however it is limited to creation of inverter and converter, translation of project into simulation without a clear physical project and not abiding to allowed frequency. This is proven by observation that there is lack of technique being explained in innovation and limited technical information given. Hence the development of wireless power transfer is slow and its market potential is still unclear. In order for the wireless power transfer to be beneficial for the lifestyle of community, it should be produced according to specification and its ability to function should be put as priority. Therefore, the objective in this research is to develope a new topology known as superimposed technique in order to overcome the existing problem. Many researchers had designed an inverter with high power and high efficiency but in their research, it was found that the short distance has been used although the power produced is high. The energy transfer happens when the transmitter resonance with the receiver, hence the main element in WPT is a transmitter system. Higher voltage suppression by transmitter produce higher power and distance of transmission. Wireless Power Transfer is designed with capability to transfer 231Watt electrical energy for each transmitter wirelessly. A huge number of experiments are required to be completed, hence statistical analysis is needed to reduce it. Taguchi method has been used in this experiment to reduce number of experiments, cost and time. Taguchi method has reduced 98% number of experiments and improved 10% output power. Based on WPT principle, one of the important parameter is a coil. Size of coil had been explored by increasing the diameter size. 16cm and 160cm diamater size of coil had been explored using algorithm approach by Taguchi method. Result shows that by increasing the diameter size the distance had been improved by 500%. During transmission of electricity, a few factors need to be considered such as barrier and environment. In order to identify the performance of WPT, the system had been embedded in soil as a comparison with open area. The performance of transferring electrical energy by embedment in soil is explored with the distance losses in range 1% to 3%, losses for current in range 1.5% to 15% and voltage drop in range 3% to 10%. The losses is depending on the distance between transmitter and receiver. WPT system had been developed to support electrical energy from solar PV. Eventhough there are many software to identify the sun radiation but in real implementation, the manual inspection is needed. Based on HOMER analysis, annual average energy for sun radiation for daily data is 5.16kW/m². Manual inspection covered three areas in north Peninsular Malaysia. Based on development for single coil, the power system was developed to transfer 4000Wp energy from solar pv. The name of the device given is "The Chargiszi" where the purpose of the design is to supply electrical energy for mobile phone and laptop wirelessly. The minimum distance for power transfer is 130cm with efficiency of 18.42% with 42.55W (between transmitter and receiver) for ac voltage and 200cm for 5V application (14.7W). Receiver is one of the part to be used in order to avoid disconnected energy while transferring as an online power transfer. Hybrid system had been developed between online power transfer and energy storage to avoid disturbance. Design of power system based on requirement from user and enviroment must be considered before implementation of WPT technology.

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CHAPTER ONE
INTRODUCTION

1.1 Background Study

Transferring power using wires and cables are widely used in streetlights, buildings, industries and houses [1]. All the cable standards are required to abide IEEE regulation and act [2]. However, these electrical cables are exposed and at risk of being stolen, as well as being lost in the connection [3]. These conditions increased the maintenance cost. Therefore, wireless power transfer (WPT) is proposed in this research to solve the imminent problem [4]. WPT is a method of transferring electrical energy from one point to another without wires or cables [5]. There are varieties of application in WPT such as transportation [6], medical [7], and mobile charger [8]. A number of researches on wireless power transfer are focusing in low power consumption [9].

Previous WPT technologies are still scarce in number of research and there is obvious gap in this field that requires more investigations. If the technology is stable, WPT will be widely used in many applications in future, in terms of transmitting energy performance [10]. In order to capture the sine wave produced by the electromagnetic field (emf) in a coil, resonance frequency is used. Configuration of coils plays a significant role in determining the strength of resonance frequency [11]. The method is not new, however many researches are unable to explain the actual amount of power transferred as well as the distance incurred in details. Most researches can only explain the concept, frequency and the efficiency of the system in certain part in WPT. A basic diagram for wireless power transfer technology using resonance frequency is shown in Figure 1.1.

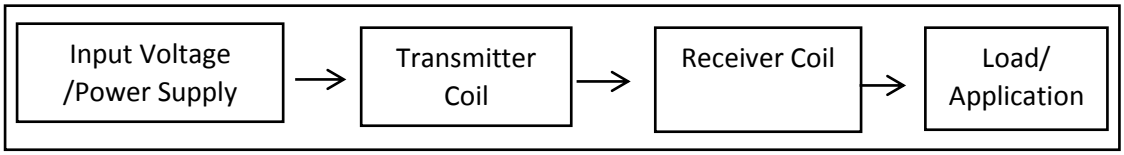

Figure 1.1 Basic Block Diagram for Wireless Power Transfer

Figure 1.1 shows how a direct current power supply is transferred through the coil. Current flow produces emf around the coil. The receiver coil is needed to capture