Wireless Power Transfer (WPT) for Electric Vehicles Charging (Evs) using Piezo Electric Sensors

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Abstract - Various non-contacting methods of plug-in electric vehicle charging are either under development or now deployed as aftermarket options in the light-duty automotive market. Wireless power transfer (WPT) is now the accepted term for wireless charging and is used synonymously for inductive power transfer and magnetic resonance coupling. WPT technology is in its infancy; standardization is lacking, especially on interoperability, center frequency selection, magnetic fringe field suppression, and the methods employed for power flow regulation. This paper proposes a new analysis concept for power flow in WPT in which the primary provides frequency selection and the tuned secondary, with its resemblance to a power transmission network having a reactive power voltage control, is analyzed as a transmission network. Analysis is supported with experimental data taken from Oak Ridge National Laboratory’s WPT apparatus. This paper also provides an experimental evidence for frequency selection, fringe field assessment, and the need for low-latency communications in the feedback path.

Keywords: piezo material, wireless power transfer, Inductive method, battery.

I. INTRODUCTION

The population of the India is increasing rapidly with some economic issues. The demand of the electricity is also high where various technologies have been introduced and partially implemented. But most of them seems to be creating environmental issues. So PEVs have been proposed as the efficient method of transportation to address environment, energy and many other problems. Due to the receiving of many government subsidy and tax incentives, EVs have not become an attractive solution to consumers. One of the major drawback of EV is with the energy storage technology. Cost, size, weight, slower charging and low energy density are some of the short comings of today’s battery technology. For example, energy density of commercial Lithium-Ion complete battery pack is around 100 Wh/kg. This value is much smaller than that of gasoline engine. It would be infeasible to achieve range of a gasoline vehicle from a pure PEV with current battery technology. Long charging times and mechanical hassles with charging cables are main drawbacks of present PEV technology that impedes the widespread proliferation of PEVs. By means of using this technology the vehicles can be efficiently charged in rapid manner.

II. EXISTING SYSTEM

The online electric vehicle (OLEV) is an innovative electric transportation system which remotely picks up electricity from power transmitted buried underground. Unlike a conventional electric vehicle that requires significant recharging downtime. In this method battery is charged even when the vehicle is in motion so the battery won’t empty the process will go smoothly without any interrupt. The software for this paper is developed and the hardware is in progress. The major drawback while we are making the hardware is power allocation for transmitter so in order to avoid that the following paper is developed. In this paper we first introduce the system design issues of the high transportation system operating with OLEV. Then we present a mathematical model and an optimization method to provide the power transmitters and to find the battery capacity of the OLEV-based mass transportation system. Even though the cost of the power transmitter is so high. In order to overcome this defect in this paper we are extended the technique were the power generation is based upon the piezoelectric crystal.

III. PROPOSED SYSTEM

A. Working methodology

Fig 3.1 shows the proposing method for wireless power transfer with the help of piezo electric. Large number of piezoelectric sensors are placed in mat for energy harvesting purpose. The piezo electric sensor which converts mechanical energy into electrical energy. The voltage from piezo electric sensor is given to the dc-to-dc converter, which boosts the voltage. This boosted dc voltage is measured by using volt meter and is stored in battery. The dc voltage is converted into ac voltage by using dc to ac inverter. Dc to ac inverter is a high frequency inverter, So it has high efficiency and less loss. The ac voltage from inverter is given to the primary coil. While passing the electrical energy from primary to secondary coil there will be some loss like eddy current loss etc. So, In order to strength the electrical energy high frequency converter is used which can also convert the following ac voltage into dc voltage in order to store the following voltage in battery.
1. **Piezo Plate**

A piezoelectric sensor is a device which uses the piezoelectric effect to measure pressure, acceleration, strain, force by converting them to an electrical charge. The rise of piezoelectric technology is directly related to a set of inherent advantages. The high modulus of elasticity of many piezoelectric materials is comparable to that of many metals and goes up to 106 N/m² [citation needed]. Even though piezoelectric sensors are electromechanical systems that react to compression, the sensing elements show almost zero deflection. This is the reason why piezoelectric sensors are so rugged, have an extremely high natural frequency and an excellent linearity over a wide amplitude range. Additionally, piezoelectric technology is insensitive to electromagnetic fields and radiation, enabling measurements under harsh conditions. Some materials used (especially gallium phosphate or tourmaline) have an extreme stability even at high temperature, enabling sensors to have a working range of up to 1000 °C. Tourmaline shows pyroelectricity in addition to the piezoelectric effect; this is the ability to generate an electrical signal when the temperature of the crystal changes. This effect is also common to piezo ceramic materials.

2. **Rectifier**

A rectifier is an electrical device that converts alternating current (AC), which periodically reverse direction, to direct current (DC), which flows in only one direction. The process is known as rectification. Physically, rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, copper and selenium oxide rectifiers, semiconductor diodes, rectifiers and other silicon-based semiconductor switches. Historically, even synchronous electromechanical switches and motors have been used. Early radio receivers, called crystal radios, used a "cat's whisker" of fine wire pressing on a crystal of galena (lead sulfide) to serve as a point-contact rectifier or "crystal detector".

3. **DC-DC converter**

Rectifier circuits may be single-phase or multi-phase (three being the most common number of phases). Most low power rectifiers for domestic equipment are single-phase, but three-phase rectification is very important for industrial applications and for the transmission of energy as DC (HVDC). Half-wave rectification in half wave rectification of a single-phase supply only, either the positive or negative half of the AC wave is passed, other the other half is blocked. Because their only one half of the input waveform reaches the output, while voltage is lower. Half-wave rectification requires a single diode in a single-phase supply and three in a three-phase supply.

A power inverter, or inverter, is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). The input voltage, frequency output voltage and overall power handling depend on the design of the specific device. The inverter does not supply any power; the power is provided by the DC source. A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry. Static inverters do not use moving parts in the conversion process.

4. **Atmega 8A microcontroller**

In this paper, ATMEGA 8A controller is used for the loading program. AVR family consists of various versions and particularly 8A selected because of its high end performance with low input. In this port B is absent and it consist of 32*8 general purpose working register. The operation performed by this microcontroller is fully static. We can write/erase cycles of about 10,000 flash or 1,00,000 flash by using EEPROM.

It consists of real time counter with separate oscillator.

In order to count the number of vehicles the following count will be stored in 1kbyte internal SRAM.

![Figures and diagrams](image-url)

Fig 3.1. Proposed Block Diagram

Fig 3.2 Pin Configuration of ATMEGA 8A

The operating voltage of the ATMEGA is 2.2-5.5 volts where the consuming input is low compared to other. It is performing with advanced RISC architecture with non-volatile memory segments. It allows 130 instructions which is normally high compared to other and it comprises of 16 bit address with 8 bit data. The data retention of the ATMEGA 8A is 20 years at 85°C and 100 years at 25°C. The peripheral features includes two 8-bit Timer/Counters with Separate pre scalar, one Compare Mode One 16-bit Timer/Counter with Separate Pre scalar, Compare Mode, and Capture Mode. One of the special features of controller is Power-on Reset and Programmable Brown-out Detection with Internally Calibrated RC Oscillator. It can be varied with five sleep modes like Idle, ADC Noise Reduction, Power-save, Power-down, and Standby.

5. **Coil**

A coil is an electrical device that can transfers energy between two or more circuits through electromagnetic induction. A varying current in the transformer's primary winding creates a varying magnetic flux in the core and a...
V. VOLTAGE TRANSFER METHODS

VOLTAGE TRANSFER METHODS encompass technologies such as Laser, photoelectric, radio waves (RF), microwave, inductive coupling and magnetic resonance coupling. These technologies can be broadly categorized based on underlying mechanism, transmission range, and power rating. Based on the power transfer distance wireless energy transfer methods can be categorized into two types; near field and far field. If transfer distance is longer than the wavelength of electromagnetic wave, it is categorized in to far field technique. Laser, photoelectric, RF, microwave can be considered as far field energy transfer methods. Inductive coupling and magnetic resonance coupling based methods are regarded as near field approaches. Even though far field techniques have transmission range up to several kilometers, they suffer from the trade-off between directionality and efficiency. Frequency range of far field approaches are typically very high (GHz range) compared to near field (kHz–MHz). Inductively coupled near field approaches can be used to transmit high power efficiently in very near range (up to several centimeters). Efficiency of such systems deteriorates exponentially with the distance. The non-radiative WPT system demonstrated in 2007 by MIT based on magnetic resonance coupling can be used in mid-range application with an acceptable efficiency. This MIT experiment has gained accentuating attention from the research community because many real world applications require longer transmission range. The main advantages of using WPT are Wireless and fast charging of electric vehicle, efficiency is greater than 95% at the same time power loss is very low.

IV. WIRELESS ENERGY TRANSFER METHODS

Wireless power transfer methods encompass technologies such as Laser, photoelectric, radio waves (RF), microwave, inductive coupling and magnetic resonance coupling. These technologies can be broadly categorized based on underlying mechanism, transmission range, and power rating. Based on the power transfer distance wireless energy transfer methods can be categorized into two types; near field and far field. If transfer distance is longer than the wavelength of electromagnetic wave, it is categorized in to far field technique. Laser, photoelectric, RF, microwave can be considered as far field energy transfer methods. Inductive coupling and magnetic resonance coupling based methods are regarded as near field approaches. Even though far field techniques have transmission range up to several kilometers, they suffer from the trade-off between directionality and efficiency. Frequency range of far field approaches are typically very high (GHz range) compared to near field (kHz–MHz). Inductively coupled near field approaches can be used to transmit high power efficiently in very near range (up to several centimeters). Efficiency of such systems deteriorates exponentially with the distance. The non-radiative WPT system demonstrated in 2007 by MIT based on magnetic resonance coupling can be used in mid-range application with an acceptable efficiency. This MIT experiment has gained accentuating attention from the research community because many real world applications require longer transmission range. The main advantages of using WPT are Wireless and fast charging of electric vehicle, efficiency is greater than 95% at the same time power loss is very low.

V. CONCLUSION

This paper summarizes a new analysis process for the computation of wireless charging technology and its performance as documented at the ORNL during the execution of a technology demonstration project funded by the U.S. DOE. The approach taken is novel in that primary-side power regulation is selected and developed with the aim to minimize vehicle on board complexity, size, and cost while retaining key scalability features considered necessary to meet future higher power WPT applications. The specific analysis methodology employed develops beyond the power electronic fundamentals used to compute the electric current flow from an ac source through a line inductance into a fixed dc voltage load, such as a battery, via a diode rectifier. Another unique feature of the ORNL primary-side regulation method is a separate treatment of secondary and primary sides of the magnetic resonance coupler. For the secondary, the analysis parallels that of a utility network or a micro grid in which reactive power compensation is utilized for voltage control, which in a WPT system, is the voltage appearing at the input of the full-wave rectifier. The primary side of the coupler on the other hand is treated as the center frequency selectivity stage needed to insure that a high mutual flux is developed, that in turn facilitates power transmission. In addition to these key aspects of the ORNL approach is the specific treatment of coupler misalignment, variable coupling gap, and leakage field containment all supported with experimental evidence. A thorough compilation of relevant citations are grouped by WPT focus area.

REFERENCES

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