Wireless power transfer for Battery Management System in Electric Vehicle Applications

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Abstract - Wireless power transfer (WPT) using magnetic resonance is the technology which could set human free from than annoying wires. In fact, the WPT adopts the same basic theory which has already been developed for at least 30 years with the term inductive power transfer (IPT). WPT technology is developing rapidly in recent years. At kilowatts power level, the transfer distance increases from several millimeters to several hundred millimeters with a grid to load efficiency above 90%.

The advances make the WPT very attractive to the electric vehicle(EV) charging applications in both stationary and dynamic charging scenarios. This paper reviewed the technologies in the WPT area applicable to EV wireless charging. By introducing WPT in EVs, the obstacles of charging time, range and cost can be easily mitigated. Battery technology is no longer relevant in the mass market penetration of EVs. It is hoped that researcher could be encouraged by the state-of-the-art achievements, and push forward the further development of WPT as well as the expansion of EV.

Index Terms – WPT, Electric Vehicles, Arduino, Electromagnetic

I. INTRODUCTION

Wireless power transfer (WPT), wireless power transmission, wireless energy transmission, or electromagnetic power transfer is the transmission of electrical energy from a power source to an electrical load, such as an electrical power grid or appliance, without the use of conductors like wires or cables. Wireless power is a generic term that refers to a number of different power transmission technologies that use time-varying electric, magnetic, or electromagnetic fields.

Wireless power techniques mainly fall into two categories, non-radiative and radiative. In near field or non-radiative techniques, power is transferred by magnetic fields using inductive coupling between coils of wire, or by electric fields using capacitive coupling between metal electrodes. Inductive coupling is the most widely used wireless technology; its applications include electric toothbrush chargers, RFID tags, smartcards, and chargers for implantable medical devices like artificial cardiac pacemakers, and inductive powering or charging of electric vehicles like SCM aglev ,trains ,AGV or buses. A current focus is to develop wireless systems to charge mobile and handheld computing devices such as cell phones ,digital music players and portable computers without being tethered to a wall plug.

In far-field or radiative techniques, also called power beaming, power is transferred by beams of electromagnetic radiation, like microwaves or laser beams. These techniques can transport energy longer distances but must be aimed at the receiver. Proposed applications for this type are solar power satellites, and wireless powered drone aircraft .

II. LITERATURE SURVEY

Wireless Power Transfer (WPT) is a term that includes several technologies to transmit power without connecting wires. This technology is not only useful for application where interconnecting wire is not possible (such as charging cardiac pacemakers) but also will be useful for reducing toxic material resulted from disposing of 6 billion batteries each year used for battery operated electronic devices (e.g. laptops, mobile devices and toys) [1]. There is a need for significant research to mature the technology of wireless power.

Wireless power transfer is classified into non-radiative and radiative categories depending on the mechanism of energy transfer [2]. Non-radiative or near-field (short and medium range) power transfer operates at distance less than a wavelength of the transmitted signal [3]. For short-range charging the receiver distance is less than the diameter of the transmitting coil. Inductive and capacitive coupling are two types of this charging method .In mid-range the receiver distance varies from one to ten times the diameter of the transmitting coil [4], Resonant inductive or capacitive coupling power transfer method fall into this type. Radiative or far-field power transfer operate at distance more than twice of the wavelength of transmitted signal.

This literature survey begins with a brief description of wireless power transfer history, continued with a discussion on the research done on non-radiative and radiative power transfer, followed by an introduction of formation of the first international wireless power standard (Qi) and other standards. Finally the challenges and the future of wireless power transfer are discussed.

III. PROPOSED SYSTEM

WPT for EVs has the potential to overcome the drawbacks of wired chargers and eliminate some hurdles towards vehicle electrification and sustainable mobility. Aside from its convenience compared to wired chargers, WPT can enable significant downsizing of the onboard EV battery. Take the stationary WPT for electric transit buses as an example where the onboard rechargeable battery can be downsized by at least two thirds due to the frequent “opportunity charges” while loading and unloading passengers at bus stations during bus operation. Attributable to these charges en route, it is reasonable to carry a much smaller onboard battery while still fulfilling the vehicle route requirements.

This results in a tremendous vehicle weight reduction given that the battery pack can comprise about a quarter of the weight of an all-electric transit bus for sustaining day-long operation . Battery downsizing has significant implications for lightweighting the vehicle and improving the fuel economy.

In the scenario of dynamic WPT for passenger cars on major roadways, ubiquitous charging infrastructure would theoretically allow EVs to have unconstrained range and a minimal capacity of onboard battery . Nevertheless, WPT for EVs poses additional sustainability trade-offs and concerns that have stimulated discussion in academia and industry. The trade-off is on the burden of large-scale WPT infrastructure deployment versus the benefits of battery downsizing and fuel economy improvement.

The concern is on the technical and economic feasibility of dynamic WPT and the decrease in charging performance when the vehicle is moving at high speeds. This review article summarizes both the most up-to-date technical advances of WPT technology for EV applications and the state of sustainability assessments of WPT EV systems. It aims to identify current research highlights, gaps, challenges, and opportunities of WPT 4 technology for EVs from both the technical and sustainability perspectives.

The article first introduces the fundamental theory of WPT and reviews the technical advances and challenges for both stationary and dynamic WPT.

The WPT technology, which can eliminate all the charging troublesome, is desirable by the EV owners. By wirelessly transferring energy to the EV, the charging becomes the easiest task. For a stationary WPT system, the drivers just need to park their car and leave.

BLOCK DIAGRAM -TRANSMITTER SIDE

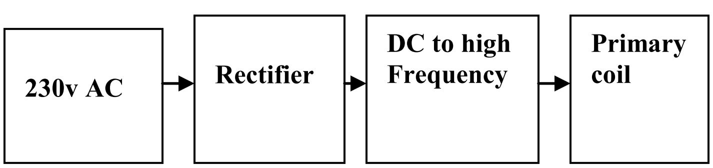
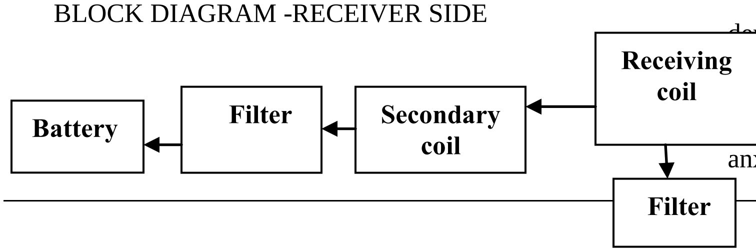


Figure 3.1.Block diagram of WPT Transmitter Side

BLOCK DIAGRAM -RECEIVER SIDE



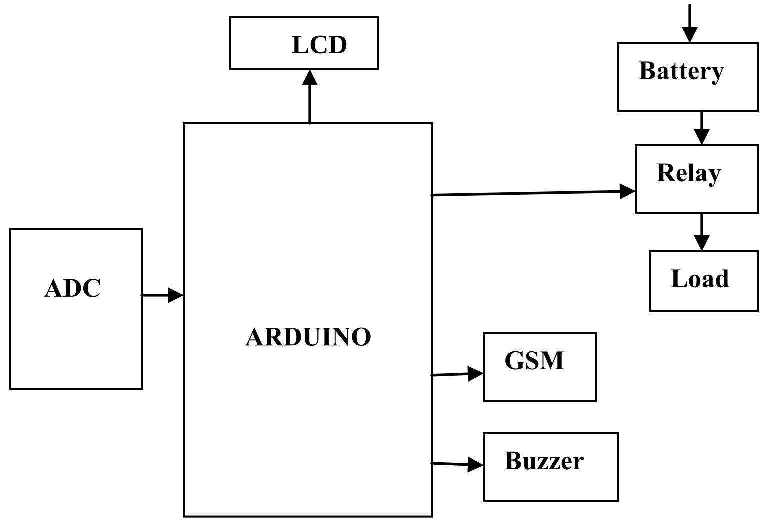


Figure 3.2.Block diagram WPT Receiver Side

IV HARDWARE IMPLEMENTION

The hardware consists of following units

a) Power supply unit
b) Arduino Uno is a microcontroller
c) GSM Module
d) GPRS Antenna
e) Power Section
f) LCD Display

Figure 3.3. Hardware Implementation

V CONCLUSION

Challenges and opportunities remain in the design and deployment of WPT EV systems. Dynamic wireless charging offers opportunities for sustaining the battery charge while driving so that the large battery pack that represents a bottleneck for deploying EVs can be eliminated and range anxiety will be reduced.

The environmental, economic and societal impacts of large scale infrastructure deployment and performance in terms of energy efficiency, durability, and reliability must be carefully evaluated for prospective real-world deployment of dynamic WPT EVs. Stationary WPT for residential and commercial charging is expected to have earlier wide spread adoption than dynamic charging given its technical maturity and economic feasibility, while dynamic WPT could be implemented gradually if the market develops enough to significantly lower the high initial infrastructure cost.

Connected and automated vehicles (CAVs)would provide strong synergy and accelerate the adoption of WPT technology by leveraging capabilities(such as charging alignment precision) to improve driving performance and energy efficiency.WPT technology also offers more active connectivity with the electric grid through V2G and G2V bidirectional power transfer, enabling EVs to become mobile energy storage devices to help regulate the grid by storing excess generation from uncontrolled renewable. In the next decade, improvements of WPT in these areas will determine how significant the role of WPT technology willbeinadvancingvehicleelectrificationandimprovingthesustainabilityofelectrifiedmobility.

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