International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

WIRELESS ELECTRIC VEHICLE BATTERY CHARGING SYSTEM

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Abstract:
Wireless charging is becoming popular all over the world to charge the electric vehicle (EV). But an EV cannot go too far with a full charge. It will need more batteries to increase its range. Dynamic wireless charging is introduced to EVs to capitally increase their driving range and get rid of heavy batteries. Some modern EVs are getting off this situation. But with Dynamic WPT the need of plug-in charge and static WPT will be removed gradually and the total run of an EV can be limitless. If we charge an EV while itis driven, we do not need to stop or think for charging it again. Eventually, in the future the batteries can be also removed from EVs by applying this method in everywhere. Wireless charging needs two kinds of coils named the transmitter coil and the receiver coil. The receiver coil will collect power from the transmitter coil while going over it in the means of mutual induction. But the variation of distance between two adjacent coils affects the wireless power transfer (WPT). To see the variation in WPT, a system of two Archimedean coils of copper is designed and simulated for vertical and horizontal misalignment in Ansys Maxwell simulation software. The transfer power for 150 mm air gap is 3.74 kW and transfer efficiency are gained up to 92.4%. The charging time is around 1 hour and 39 minutes to fully charge its battery from 0 state for a 150mm air gap for an EV with 6.1 kW power may take. Also, a charging lane is designed for dynamic charging. Then the power transfer is calculated from mutual inductance when the EV is driven on a charging lane. From the load power, it can be calculated how further an EV can go with this extra power.

INTRODUCTION.

Growing concern in the reduction of the polluting emissions due to the transportation means has led to the adoption of vehicles powered by comparatively cleaner sources of energy, such as batteries, fuel cells and so on, in place of internal combustion engine (ICE) t based vehicles.

Differently from ICE vehicles, electric vehicles (EVS) are not a matured Technology in terms of vehicle autonomy, and a lot of research efforts is being carried out by academia and industries to improve the overall performance of the these vehicles. Various solutions are being adopted to increase the autonomy of the vehicles such as conceiving batteries of higher energy density, relaxing the batteries during acceleration and regeneration by supplying and absorbing the current peaks by means of super capacitors, arranging fast chargers, charging while on move etc.

On-board batteries are typically recharged at home or at stations/parking places through conductive battery chargers. Generally two types of conductive battery chargers are used: off-board and on-board. On-board chargers can be used to charge from the utility outlet at home or at charging stations during the day time. Off-board chargers operate like a gas station and are designed to manage high powers in order toper form a fast charge.

In most of the battery chargers the power flows only from the utility grid to the battery ,and for this reason they are often termed as unidirectional battery chargers (UBCS); beside circuital simplicity, UBCS enjoy a reduced grid interconnection and lower battery degradation. On other hand, some battery chargers manages power flowing in both directions and are able to perform ancillary operation in favor of the grid, such as peakpower shaving or reactive power compensation. These battery chargers are called bidirectional battery chargers (BBCS).
Charging of an electric vehicle can be performed by either conductive (or wired) charging or wireless charging. Wired charging uses connection means between electric supply and charge inlet of the vehicle.

Even though wired charging is popular, the problems with messy wires and safety matter in wet environment are a major drawback of this charging. Since a few years, a large interest is growing for the supply of the electric loads through a field to dispense from any wired connection with the grid. The apparatuses that actuate the through-the- field supply are termed as wireless power transfer systems (WEVSS).

Their deploy month as started for the recharge of the batteries that are fitted in grid-detachable equipment. Recharging is executed while the equipment is standing inan on-purpose set but the long-time perspective is the supply of equipment whilemoving, with the purpose of removing the batteries or at least of reducing their capacity.

Wireless charging of the EV batteries offers a number of advantages compared to the wired counterpart; indeed, wireless charging makes ii) unnecessary any plug, cable or outlet, ii) friendly the charging process, iii) fearless the transfer of energy in any environmental condition, and so on. For these reasons, WEVSS are expected to play a major role in the future charging process for the EVS.

Three different technologies can be utilized to arrange a WEVSS, exploiting the properties of the electric, magnetic and electromagnetic fields. Magnetic-field technology, adopted in the so-called inductive WEVSS, is the most convenient one because it transfers much higher energy per unit of volume than the electric-field technology, and does it with much higher efficiency than the electromagnetic-field technology.
As a matter of fact, low-power inductive WEVSS with closely coupled coils are

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around since a few years. In recent times , however, interest is arisen in transferring energy at medium-high power to an equipment at a somewhat far distance.For these applications, inductive WEVSS with resonant topology (shortly, resonantWEVSS) are used. This, for instance, is the case of the wireless charging of the EV batteries.

The general scheme of a resonant WEVSS is shown in Fig. It consists of two sections: transmitting and receiving, each of them including a coil that is coupled to the other onewith a large air-gap in between. Both the WEVSS sections are equipped with power conversion circuitry. On the transmitting section, the grid feeds the relevant coil through a diode rectifier with output capacitor and an in-cascade inverter operating at high frequency. Grid, rectifier and battery constitute the supply of the transmitting coil and are equivalent to a sinusoidal generator with an in-series resistance, where the frequency of the generator is the inverter frequency.

To achieve a good power factor, the diode rectifier is normally substituted for by a PFC rectifier. On the receiving section, the voltage induced across the receiving coil charges the battery pack through another capacitor-output diode rectifier and an in-cascade chopper, which adapts its output current/voltage to the battery charging requirements
.Rectifier, chopper and battery constitute the load of the receiving coil and are equivalent to a resistance.

Coupling structure crucially affects the performance of a WEVS system. Various coil arrangements are documented in literature but two arrangements are frequently used in EV charging applications, namely helix and spiral. Spiral coils can take many forms with rectangular and circular turns, and offer more flexibility for optimizing the coil geometry ,what makes them particularly attractive for EV charging applications. Coil alignment is one of the major issue for WEVS. Because of the tolerance in the vehicle parking maneuver, the receiving coil may be not perfectly aligned with the transmittingcoil during EV charging process. This reduces the coupling coefficient compared to that one in aligned conditions with a consequent decrease of the efficiency in the powertransfer.By the resonant topology, the inductance of the coils are compensated for by capacitors inserted either in series or in parallel to the coils and tuned to make resonant the coil- capacitor branches at the supply frequency. Four basic technologies of resonant WEVSS can be found: series-series (SS), series-parallel (SP), parallel-series (PS) and parallel-parallel (PP),depending on the connection (series or parallel) of the capacitors with respect to the coils in the two sections of the WEVSS.

Operation of a WEVSS requires power electronics circuitry. The power circuitry supplying the transmitting coil includes a high-frequency inverter and a diode rectifier that also works at high frequency. High-frequency operation is conveniently implemented by using new generation devices like SiC/GaN to keep high the efficiency of the system. DC voltage across the output capacitor of the rectifier in the receiving section is controlled by acting on the magnitude of the output voltage of the inverter placed in the transmitting section.

Emerging issues in wireless power charging of the EV are i) dynamic (or on- line)charging, ii) shielding the magnetic fields nearby the WEVSS, and iii) standards under issue to regulate the setup of the WEVSS. Online charging is a technique to charge the battery of an EV while the vehicle is in motion, with the transmitter that is formed by tracks embedded in the ground. The Korean Advanced Institute of Science and Technology (KAIST) introduced dynamic charging, termed by its researchers as On Line EV (OLEV) charging technology, in a commercial application (the zoo of Seoul). Shielding of the magnetic field out of the transmitting coil is a significant issueto be faced in a WEVSS to protect the biological organs from its effects; two types of shielding are commonly used for this purpose, i.e. passive and active shielding.

Literature Survey:

TITLE- The state-of-the-arts of wireless electric vehicle charging viamagnetic resonance.

AUTHOR- Songa niu

With the growing adoption of electric vehicles (EVs), there is a pressing need for constructing charging infrastructures. In this context, wireless charging technology has been under development technical development and currently valid policies, the authorenvisions the future of WEVC.
For the past few decades. Dispensed with awkward plugs and wires, wireless power transfer (WPT) technology is very safe, convenient and easy-to-use. Researchers have taken sustained efforts to make it an improved technology and automakers also work toprovide the wireless charging option for their customers.
In this paper, the basic principles of resonant inductive power transfer that is common-used for wireless electric vehicle charging (WEVC) are elaborated.
Then, with a different emphasis on WEVC technologies, the key issues in academia and industry are discussed respectively. The core technologies of a fully-function WEVC system in academia are summarized and a comparative study is conducted among the selected WEVC industry standards.

TITLE - Survey of the operation and system study on wireless charging electricvehicle systems

AUTHOR- Young Jae Jang

Transportation Research Part C: Emerging Technologies 95, 844-866, 2018

This survey investigates the state-of-the-art in operations and systems-related studies of wireless charging

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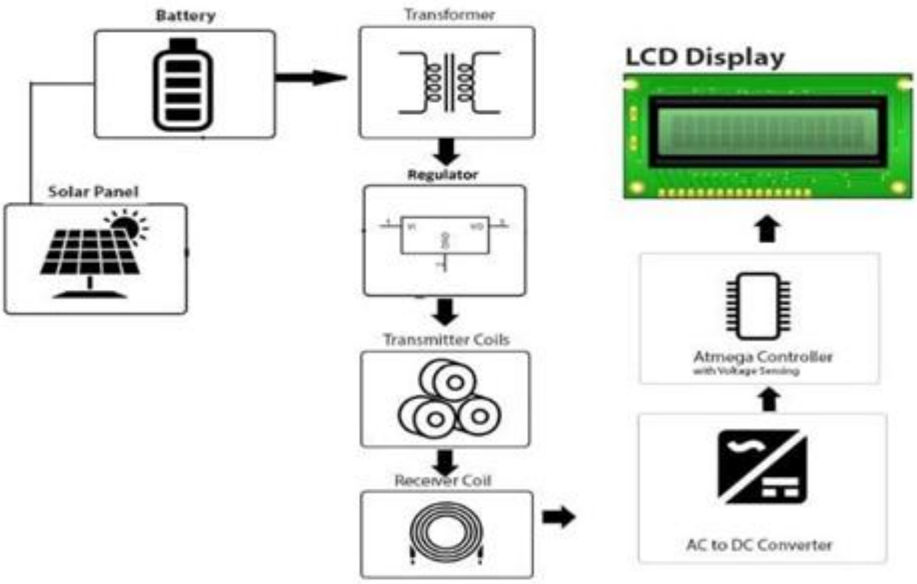
electric vehicles (EVs). The wireless charging EV is one of emerging transportation systems in which the EV's battery is charged via wireless power transfer (WPT) technology. The system makes use of charging infrastructure embedded under the surface of the road that transfers electric power to the vehicle while it is in transit. The survey focuses on studies related to both dynamic and quasi-dynamic types of wireless charging EV – charging while in motion and while temporarily stopped duringa trip, respectively. The ability to charge EVs while in transit has raised numerous operations and systems issues that had not been observed in conventional EVs. This paper surveys the current research on such issues, including decisions on the allocation of charging infrastructure; cost and benefit analyses; billing and pricing; and other supporting operations and facilities. This survey consists of three parts. The first provides an orienting review of terminology specific to wireless charging EVs; it also reviews some past and ongoing developments and implementations of wireless charging EVs. The second part surveys the research on the operations and systems issues prompted by wireless charging EVs. The third part proposes future research directions. The goal of the survey is to provide researchers and practitioners with an overview of research trends and to provide a guide to promising future research directions.

METHODOLOGY

SYSTEM MODELLING AND DESIGN



Block Diagram

The system makes use of a solar panel, battery, transformer, regulator circuitry, copper coils, AC to DC converter, atmega controller and LCD display to develop the system. The system demonstrates how electric vehicles can be charged while moving on road, eliminating the need to stop for charging.

The solar panel is used to power the battery through a charge controller. The battery is charged and stores dc power. The DC power now needs to be converted to AC for transmission. For this purpose we here use a transformer.

The power is converted to AC using transformer and the regulated using regulator circuitry. This power is now used to power the copper coils that are used for wireless energy transmission. A copper coil is also mounted underneath the electric vehicle.

When the vehicle is driven over the coils energy is transmitted from the transmitter coil to ev coil. Please note the energy is still DC current that is induced into this coil. Now we convert this to DC again so that it can be used to charge the EV battery.

We use AC to DC conversion circuitry to convert it back to DC current. Now we also measure the input voltage using an atmega micro controller and display this on an LCD display. Thus the system demonstrates a solar powered wireless charging system for electric vehicle that can be integrated in the road.

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SYSTEM DESIGN

Well here we develop an EV charging system that solves both these problems with a uniqueinnovative solution. This EV charging system delivers following benefits:

- Wireless charging of vehicles without any wires
- No need to stop for charging, vehicle charges while moving
- Solar power for keeping the charging system going
- No external power supply needed
- Coils integrated in road to avoid wear and tear.

Conclusion:

An Inductive Power Transfer (IPT) system for an E-bike battery charging has been designed and assembled. The target is a 36 V 10 Ah LiFePO4 battery and the powerlevel ranges from 100 W to 250 W.
After the magnetic design of the IPT coils, the electric model of the coupling structure has been gained and acquired from an electronic simulation tool, in order tocomplete the design of the whole system.

A series-series (SS) compensation topology has been chosen for the capacitive net work that has been connected to the coupled coils. In the assembled open-loop prototype, a half-bridge converter in the transmitter side and a four-diode rectifier in the receiver sidehave been designed.

From the experimental results, a 79 % coupling efficiency for an about 100Wlevel arises.A magnetic characterization of the region surrounding the assembled proto type has beenmade as well. According to the magnetic field exposure guidelines, by ICNIRP, a minimum 25 cm distance from the center of the system is suggested as safety distance
.After the experimental measurements on the power efficiency, alternative solutions ofpower electronics and coupling structures have been investigated.
A Bi-Directional IPT system has been analyzed and an algorithm for its efficiencyoptimization has been proposed. Mathematical analysis has been validated throughpower electronics simulations.
For this system, an investigation has been carried out on different magnetic coupling structures, all compliant with an E-bike wheel, and the best option in terms of system efficiency and tolerance to lateral misalignment has been defined.
The investigation has been made according to the results of 3D magnetic simulations andheir elaboration.

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REFERENCES

1. S. Asheer , A. Al-Marawani, T. Khattab, and A. Massoud, “Inductive power transfer with wireless communication system for electric vehicles,” in GCC Conference and Exhibition (GCC), 2013 7th IEEE, 2013, pp. 517–522.
2. H. Z. Z. Beh, G. A. Covic, and J. T. Boys, “Wireless Fleet Charging System for Electric Bicycles,” Emerging and Selected Topics in Power Electronics,IEEE Journal of, vol. 3, no. 1, pp. 75–86, Mar. 2015.
3. V. Boscaino, F. Pellitteri, L. R. R., and C. G., “Wireless battery chargers for portable applications: design and test of a high-efficiency power receiver,”IET Power Electronics, vol. 6, pp. 20–29, 2013.
4. G. Jung, B. Song, S. Shin, S. Lee, J. Shin, Y. Kim, C. Lee, and S. Jung,“ Wireless charging system for On-Line Electric Bus(OLEB) with series- connected road-embedded segment,” in Environment and Electrical Engineering (EEEIC), 2013 12th International Conference on, 2013, pp. 485–488.
5. J. Li, P. Li, H. Liu, D. Li, and J. Tang, “A contactless battery charging and monitoring system for wireless sensor network nodes,” in Computer Science and Network Technology (ICCSNT), 2011 International Conference on, 2011, vol. 3, pp. 1923–1926.
6. R. W. Porto, V. J. Brusamarello, I. Muller, and F. R. de Sousa, “Design and characterization of a power transfer inductive link for wireless sensor network nodes,” in Instrumentation and Measurement Technology Conference (I2MTC), 2015 IEEE International, 2015, pp. 1261–1266.
7. Y. Shi, L. Xie, Y. T. Hou, and H. D. Sherali, “On renewable sensor networks with wireless energy transfer,” in INFOCOM, 2011 Proceedings IEEE, 2011, pp. 1350–1358.