



REVIEW OF WIRELESS CHARGING TECHNOLOGY

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Abstract

Wireless charging Technology has been the centre of discussion ever since smartphones have come into human life. How can we make smartphone charging wireless? This is a pretty old question has most companies like Apple, Samsung, etc..., have already developed the wireless charging in case of smartphone and have extended it to other products. This technology has been in works to adopt to Electric vehicles, has this enable us to more safe, contactless, and reliable mode of charging. Already EVs have been using wired charging, which is a very efficient way but has few disadvantages over wireless charging. In this paper, we would like to discuss the possible mechanics that can be adopted in developing Wireless charging technology in electric vehicles such as cars, motorcycles, buses etc. Further, we will discuss about the challenges in implementing wireless charging technology.

Introduction

Wireless charging has been around ever since Nicola tesla demonstrated magnetic resonant coupling, which is the ability to transmit electricity through the air by creating a magnetic field between two coils. Of the two coils one coil acts as a transmitter and device containing second coil in the form Receiver. Wireless charging is majorly of three types' namely inductive coupling, Magnetic resonance coupling, and RF Radiation.

Inductive coupling: When a primary coil of an energy transmitter generates predominantly varying magnetic field across the secondary coil of the energy receiver within the field. This induces current/voltage across the secondary coil, which can stored in a storage system. This type of Wireless charging technology works upto 30cm as published by MIT scientists thorough the invention of a novel wireless charging technology, called MagMIMO.

Magnetic Resonance Coupling: When two coils are placed over a same plane such that they are tuned to resonate at same frequency. This resonance occurs between the coils due to oscillating magnetic fields. This type of wireless charging technology works around few centimetres to few meters.

RF Radiation: RF radiation utilizes diffused RF/microwave as a medium to carry radiant energy. RF/microwave propagates over space at the speed of light, normally in line-of-sight. The typical frequency of RF/microwave ranges from 300MHz to 300GHz. This works within several tens of meters up to several kilometers.

Of all the different forms of wireless charging Inductive coupling is more suitable for static wireless charging technology whereas RF Radiation is more suitable for dynamical wireless charging technology. Wireless charging can be divided into two different types based on requirements of specific vehicles has storage vary form one vehicle to another and so is its power requirements.

Static wireless charging: In this method we should make use of Inductive coupling has this method is easy to implement and efficiency is very high. This system must be designed such that no humans are needed to step out in order to start the charging. As soon as the EVs is stops over the coil the wireless charging will automatically start. We further develop such system to every parking lot to start charging EVs whenever they come a stop, hence we can no longer vary about battery storage capacity.

The major disadvantage of such Inductive coupling is the loss of energy in the form of heat, Need of proper alignment of charger with the charging devices which in poor case connectivity can cause large energy loss.

Dynamical Wireless charging: Dynamical Wireless charging is a step extending the static charging has this can provide continues supply of electric juice required for transportation. The setup for this more or less similar to that of static, here we will need to implant primary coil on the outer boundaries of the roads such that higher efficiency can be achieved. The secondary coil which will be built into the Electric vehicle will help us to transfer current/voltage to a storage of the electric. If we can implement such systems across an area, any electric vehicle can move around the area without any battery due the continuous supply of current/voltage. In order to implement this take a very time to study about all the factors like weather, material, cost, etc..., this technology can be future dystopia where we move away from using petrol, diesel, and other non-renewable sources.

Challenge and possible Solutions

Wireless charging technology has greater Advantages but come in with great deal of disadvantages concerning with its Efficiency, overcharging, Construction, cost of building and maintaining it.

Cost: This technology cost a large amount for the government (or specified company) to take into action. But, this is the future as Fossil fuels are degrading every day. As well the cost of petrol as reached a record high (India 1 litre cost >100). The cost for full charge of an Electric vehicle is around 2500Rs which can last for about 150km on single charge.

Implementation: A filled Fuel/Gas based vehicle travels larger distance when compared that of an EV. So, in order to overcome this we need to plant more charging setups. As this will enable larger travel distance. Also we increase the capacity of batteries in EV's. These Facilities should be placed at a parking lot of shopping complex, hotels, cinemas, apartments and other public places. So, we can charge anytime and not worry about how much charge is remaining.

Overcharging: When EV is left to charge for more then its required time to complete its charging, it can lead to damage of battery capacity. In order for this not to occur we can implant an sensors so that they can deactivate the coil in the EV and hence Stop the charging process.

Maintenance: The Implementation of this Wireless charging technology is cost big bucks, so does maintaining it. The equipment can be damaged, climates might reduce the efficiency. Proper periodic checks must be done to maintain the facility. Efficiency: we get up to about 96% efficiency in case of Wired charging. In case of Wireless Charging technology its about 92% efficient as some power is lost due to conversion of AC to DC or DC to AC during battery usage and charging respectively. This not a major issue as not much power is lost.

Conclusion

Wireless charging is the frontier of human endeavour. The use of wireless Charging Technology must be adopted across the globe as this help in reduce the greenhouse gases and thus also aids in lowering global warming. Countries like South Korea, Netherlands, U.K, and Italy have been testing electric buses. As of now static Electric charging stations are being tested in some countries, many scientist are working on dynamical Wireless charging mechanics. All the nations should come together for such project as this is more eco-friendly then other sources.

Acknowledgement

The authors would like to thank Dr. Indudhar P. Vali and Dr. Shivananda C S for meaningful discussion and their support.

References

- [1] J. Jadidian and D. Katabi, "Magnetic MIMO: How to Charge Your Phone in Your Pocket," in Proc. of the annual international conference on Mobile computing and networking (MobiCom '14), Maui, Hawaii, Sept. 2014
- [2] X. Lu, P. Wang, D. Niyato, and E. Hossain, "Dynamic Spectrum Access in Cognitive Radio Networks with RF Energy Harvesting," IEEE Wireless Communications, vol. 21, no. 3, pp. 102-110, June 2014.
- [3] X. Lu, P. Wang, D. Niyato, and Z. Han, "Resource Allocation in Wireless Networks with RF Energy Harvesting and Transfer," to appear in IEEE Network.
- [4] <https://www.powerelectronicsnews.com/wireless-charging-technology-for-evs/>
- [5] https://www.researchgate.net/publication/345714497_Wireless_Power_Transfer_System_for_Charging_of_Electric_vehicles
- [6] <https://www.powerelectronics.com/markets/automotive/article/21864097/wireless-charging-of-electric-vehicles>
- [7] https://www.researchgate.net/publication/316472465_Challenges_and_Potential_Solutions_for_the_Deployment_of_Wireless_Charging_Infrastructure_for_xEVs_in_India
- [8] Elena Paul, Nimmy Paulson, Rijo Bijoy, Benny K.K, "WIRELESS CHARGING OF ELECTRIC VEHICLES", International Research Journal of Engineering Technology, Vol.6, Issue 6, June 2019.
- [9] Asst Prof.Swapna Manurkar, Harshada Satre, Bhagyashree Kolekar, Pradnya Patil, Samidha Bailmare, "WIRELESS CHARGING OF ELECTRIC VEHICLE" International Research Journal of Engineering and Technology, Vol. 7, Issue3, mar 2020