As per UGC guidelines an electronic bar code is provided to seure your paper

International Journal for Modern Trends in Science and Technology, 7(11): 188-191, 2021

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0711031
Available online at: http://www.ijmtst.com/vol7issue11.html

A Review on Dynamic Contactless Charging for Roadster Electric Vehicles

Shefali V.Kamble[1] | Prof.Dr.Vijay N. Gohokar

[1] Assistant Professor ,Electrical Engineering Department, Sanjay Bhokare Group of Institutes, Miraj, Maharashtra, India
[2]Professor, Electrical Engineering Department, MarathwadaMitraMandal College of Engineering, Pune, Maharashtra, India

To Cite this Article
Shefali V.Kamble and Prof.Dr.Vijay N. Gohokar. A Review on Dynamic Contactless Charging for Roadster Electric Vehicles. *International Journal for Modern Trends in Science and Technology* 2021, *7*, pp. 188-191. https://doi.org/10.46501/IJMTST0711031.

Article Info
Received: 11 October 2021; Accepted: 19 November 2021; Published: 26 November 2021

ABSTRACT

This is the era of wireless communication between multiple devices as we see, as we handle, as we use those devices such as mobile, laptop, wireless speakers, etc.. But powering those devices is still wire or contact based or some energy storage devices such as batteries are used to power them. These batteries again are charged with contact based chargers. The paper shows the basic study and design of contactless batteries charger with contactless bidirectional flow of energy to charge the batteries or discharge it for the field of electric vehicle application. The design includes renewable energy source, grid source which drives the voltage to voltage converter to transfer power using transmitting tesla coil in air gap at some distance in form of flux.This flux will link with receiving tesla coil followed by voltage to voltage converter to batteries as to charge or store the energy.Contactless charge transfer drives various application fields such as contactless EV charging station, contactless jackets, roadster on moving EV charging, military border applications, contactless drives, etc which can prove vital role to avoid moving on heavy weight batteries, avoiding bulky wiring and its heavy installation cost. This system design includes the design of variable power transfer from 12v to 100v with current capacity of up to 5amperes and distance up to 1metre minimum.

KEYWORDS: Tesla coil, PWM, Bidirectional Power-flow, Lithium Ion batteries, Contactless charge

I.Introduction

The history of power transmission is found in the period starting after World War II where wireless power transmission is tested at microwave frequencies. Nicola Tesla who is indeed known as the "Father of Wireless Electricity " is the one who first developed the idea of power transmission in wireless mode. In 1893, Tesla demonstrated the implementation of vacuum bulbs without using wires for transmission at the world Exposition in Chicago in 1997. In 1904, an Airship motor of 0.1 Horsepower through space from a distance of least 100 feet. In 1961 Brown comes with first research paper proposing microwave waves used for power transmission and in 1964 he Demonstrated a breakthrough in wireless power transmission technology by transferring all the power needed to microwave powered helicopter through microwave beam at 2.45 GHz. from the range of 2.4 GHz -2.5 GHz frequency band [6]. From this event the research in Wireless power transfer accelerated at high speed. During 1975-1997 time period various experiments demonstrated on the application of wireless power transfer. Experiments in power transmission without wires in the range often of kilowatts have been performed at Goldstone in California in 1975 and at Grand Bassin on Reunion Island in 1997[5].

World's first microwave power Transfer experiment in the ionosphere called the MINIX Microwave Ionosphere Non-Linear Interaction Experiment rocket experiment is demonstrated by Japan in 1983. Similarly, the World's first fuel free airplane based on microwave energy transfer was flown in 1987 from Canada [6] .In 2015 aSouth Korean Company named Samsung Launched World's. first "Wireless Charging Mobile Phones" named Samsung Galaxy note 5 and Samsung Galaxy age+ respectively [2].

Research on wireless power transfer got pace in 20th century as need of electricity is increasing day by day wireless power transfer came in picture. most of the asian countries are continuously making research on wireless power transfer and its applications. However the most difficult task for them is to increase the range of transmission with minimum loss and higher efficiency. until year 2000 wireless power transmission is limited to only Electricity but after 2000 wireless power transfer got Scope in many Fields which are directly or indirectly related to Electricity Such as Telecommunication, Transportation, Mobile and other electronic devices and wireless communication [2]. Since the pioneer work done by Grover and Sahai, wireless information and power transfer (WIPT) has spurred considerable interest from academia and industry, especially in the area of wireless communications. Nowadays, most wireless devices are powered via power cables or battery replacements, which limit the scalability, sustainability, and mobility of wireless communications. In late 2008, the Wireless Power Consortium (WPC) has been created in order to unify the powering protocols related to inductive WPT systems. In October 2011, 100 companies have come up with innovative solutions of powering or charging consumer electronic devices using WPT [3]. Basically the WPC aims to set the standard for interoperable wireless charging. Recently Electric Vehicle Concept is becoming popular and lots of research has been done on Electric Vehicle and its Parameters like Electricity Storage. in 2014 Jaegue Shin, Seungyong Shin, Yangsu Kim, SeungyoungAhn, , SeokhwanLee,Guho Jung, Seong-JeubJeon, , and Dong-Ho Cho proposed magnetic Resonance Based Wireless Power Transfer System for Electric Vehicle.in 2015 Siqi Li and Chunting Chris Mi proposed a "Wireless Vehicle Charging For Electric Vehicle" System in which electric vehicle get charged from energy transmitted by electric storage system placed under the road [21]. Some of the thesis inspects the present status, latest deployment and challenging issues in the implementation of EVs infrastructural and charging systems in conjunction with several international standards and charging codes. It further analyzes EVs impacts and prospects in society.[1]. The thesis highlights international standards regarding charging methods, grid integration, power quality issues, safety limitations, communication networks and equipment maintenance which are required for large-scale deployment of EVs. Furthermore, a complete assessment of charging systems including: inductive charging, conductive charging and battery swapping networks for EVs with various kinds of fast and slow battery charging techniques is explained. Moreover, the beneficial and harmful impacts of EVs are categorized and thoroughly reviewed with remedial measures for harmful impacts and prolific benefits for beneficial impacts.[22]. Bidirectional charging offers the fundamental feature of vehicle-to-grid technology. The optimal charging methodologies should be adopted to control the issues of EVs impacts.[1] Some of research has been done on bidirectional wireless power in V2G system. There are different types of methods for wireless transmission. For Electric vehicles Inductive power transfer is appropriate method. Different experiments have been done on Tesla coils and E transformer core. Both experiments gave different results. After doing these experiments final result has been concluded. 81% efficiency has been achieved from this research, But by increase the distance range of project up to 30 cm which itself a very unique achievement. 15 cm is desired distance and more than it has been achieved. The output Voltage and output current at 30 cm distance between coils are 12 V and 3 A DC respectively which is good for charging a electric vehicle[2]. In this letter, a large air-gap bidirectional WPT EV charger with SR-PWM method has been proposed. The proposed method has a simple structure without additional current chopper and it can cope with a large air-gap power transfer with constant frequency PWM. Operation has been analyzed and design guideline has been derived based on this analysis. To verify the performance, a 6.6-kW prototype charger with air-gap of 12–20 cm has been implemented with the design guideline and efficiency of 88.1–95.3% has been recorded at full load condition. Therefore, it may be suitable for bidirectional wireless chargers requiring for large air-gap and constant switching frequency[3]. Some practices presented a review of wireless charging of electric vehicles. It is clear that vehicle electrification is unavoidable because of environment and energy related issues. Wireless charging will provide many benefits as compared with wired charging. In particular, when the roads are electrified with wireless charging capability, it will provide the foundation for mass market penetration for EV regardless of battery technology. With technology development, wireless charging of EV can be brought to fruition. Further studies in topology, control, inverter design, and human safety are still needed in the near term.[4].

In some recent development suggest that on road dynamic charging reduces battery storage requirement and makes EV eco friendly system using contactless charging.[5] some researches has be developing mobile energy disseminators using spiral coils means dynamic contactless battery chargers for on road moving vehicles.[23].

II. SYSTEM DESIGN

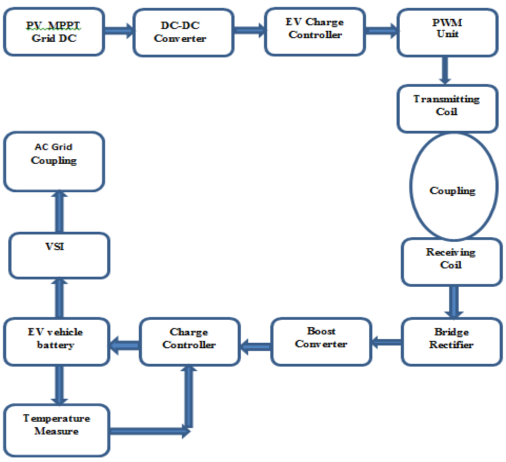

Figure1: Basic Block Diagram

Wireless Power Transfer and its application can be extremely useful in Electricity Generation and transmission. Wireless Power transfer is basically works on the principle of Transformers. We can say that transformer is a motive of wireless power transfer. it is analogues to wireless data transmission only power is transmitted instead of data. the concept can be used efficiently in Electricity to minimize Cost, losses and maximize the Efficiency. Concluding to this development a system that could provide much higher Efficiency, low transmission cost and secured to power theft. In proposed system we are developing a bidirectional wireless power transmission system in which vehicles battery will be charged a on grid/pv system. EV Vehicles can also provide power to required gadgets. Generally any road has more than thousand vehicles running on it per day. If we collect energy from each vehicle without hampering its operation this energy can be used for feeding street lights on that road. It can be effective option to curb these losses. This give and take power makes system contactless bidirectional power flow.

Block diagram in Figure.1 shows the basic building blocks for bidirectional contactless EV charger/discharger. Transmitter side consists of PV array/grid with MPPT tracking unit followed by DC-DC buck-boost converter with charge controller unit. MPPT unit will help to stabilize the power output from pv array against variation in sunlight with respect to time in day mode. In night mode power will be taken from grid. Controller unit will stabilize power given to tesla coil via controlling PWM switching to switching devices like IGBT, MOSFETS, etc. through PWM dc power is converted to pulsating square as coil requires AC power. Transmitting coil will generate flux which will be spread over air. This flux will link with receiving coil that will generate voltage and current in pulsating form which has to be converted to dc using rectifier filter to get dc supply. According to battery voltage boost converter with controller unit will adjust or convert the supply power varies from 12v to 80v with constant voltage and constant current mode based lithium ion battery will be charged. As system is bidirectional power flow vehicle battery can provide power to grid via VSI unit which is voltage source inverter followed by coupling unit to send power to grid. This system comply a wide range of applications in coming future such as contactless chargers, contactless charging stations, wide range contactless battery chargers for border/military applications, contactless streetlights, thermal jacket charging, ultrafast contactless mobile chargers, EV vehicles on road moving can be charged. System will also check battery status and condition to avoid over heating and damaging of batteries in turn avoiding catching of fire in EV vehicles due to access heat of other faults.

III. CONCLUSION

A contactless EV charger will provide wide range of applications which will provide cost effective compact size rechargeable systems from a wide or long distance. This system can minimize storage battery requirements as well as maintains health of batteries to maximize life which can make cost effective system. Bidirectional power transfer will provide on grid or off grid power flow which make system more effective in coming future.

REFERENCES

[1] Siqi Li and Chunting Chris Mi " Wireless Power Transfer For Electric vehicle applications" IEEE journal of Emerging and Selected Topics In Power Electronics, Vol. 3, No.1, March 2015

[2] A. K. A. Kurs, R. Moffatt, J. D. Joannopoulos, P. Fisher, and M. Soljacic, "Wireless power transfer via strongly coupled magnetic resonances," Science, vol. 317, no. 5834, pp. 83–86, 2007.

[3] A. P. Sample, D. A. Meyer, and J. R. Smith, "Analysis, experimental results, and range adaptation of magnetically coupled resonators for wireless power transfer," IEEE Trans. Ind. Electron., vol. 58, no. 2, pp. 544–554, Feb. 2011.

[4] B. L. Cannon, J. F. Hoburg, D. D. Stancil, and S. C. Goldstein, "Magnetic resonant. coupling as a potential means for wireless power transfer to multiple small receivers," IEEE Trans. Power Electron., vol. 24, no. 7, pp. 1819–1825, Jul. 2009.

[5] DevendraPatil and et all, Wireless power transfer for vehicular applications overview and challenges. IEEE transaction on Transportation Electrification, Vol 4 march 2018.

[6] AskinErdemGlindogdu and Dr. ErkanAfacan" Some Experiments Related to Wireless Power Transmission " Cross Strait Quad-Regional Radio Science and Wireless Technology Conference 2011

[7] Yoon Do Chung , Chang Young Lee , Hyoung Ku Kang and Young Gun Park " Design Consideration and Efficiency Comparison of Wireless power Transfer with HTS and Cooled Copper Antennas. " IEEE Transactions On Applied Superconductivity, Vol. 25, No. 3, June 2015

[8] S. J. Gerssen-Gondelach and A. P. C. Faaij, "Performance of batteries for electric vehicles on short and longer term," *J. Power Sour.*, vol. 212, pp. 111–129, Aug. 2012.

[9] A. Kurs, R. Moffatt, and M. Soljacic, "Simultaneous mid-range power transfer to multiple devices," *Appl. Phys. Lett.*, vol. 96, no. 4, pp. 044102-1–044102-3, 2010.

[10] C. Sanghoon, K. Yong-Hae, S.-Y. Kang, L. Myung-Lae, L. Jong-Moo, and T. Zyung, "Circuit-model-based analysis of a wireless energy transfer system via coupled magnetic resonances," *IEEE Trans. Ind.Electron.*, vol. 58, no. 7, pp. 2906–2914, Jul. 2011.

[11] L. C. Kwan, W. X. Zhong, and S. Y. R. Hui, "Effects of magnetic coupling of nonadjacent resonators on wireless power domino-resonator systems," *IEEE Trans. Power Electron.*, vol. 27, no. 4, pp. 1905–1916, Apr. 2012.

[12] Y. Nagatsuka, N. Ehara, Y. Kaneko, S. Abe, and T. Yasuda, "Compact contactless power transfer system for electric vehicles," in *Proc. IPEC*, Jun. 2010, pp. 807–813.

[13] C. J. Chen, T. H. Chu, C. L. Lin, and Z. C. Jou, "A study of loosely coupled coils for wireless power transfer," *IEEE Trans. Circuits Syst.*, vol. 57, no. 71, pp. 536–540, Jul. 2010.

[14] M. Budhia, G. A. Covic, and J. T. Boys, "Design and optimization of circular magnetic structures for lumped inductive power transfer systems," *IEEE Trans. Power Electron.*, vol. 26, no. 11, pp. 3096–3108, Nov. 2011.

[15] C. Wang, O. H. Stielau, and G. A. Covic, "Design considerations for a contactless electric vehicle battery charger," *IEEE Trans. Ind. Electron.*,vol. 52, no. 5, pp. 1308–1314, Oct. 2005.

[16] M. L. G. Kissin, G. A. Covic, and J. T. Boys, "Steady-state flat-pickup loading effects in polyphase inductive power transfer systems," *IEEETrans. Ind. Electron.*, vol. 58, no. 6, pp. 2274–2282, Jun. 2011.

[17] M. Zaheer, N. Patel, and A. P. Hu, "Parallel tuned contactless power pickup using saturable core reactor," in *Proc. Int. Conf. Sustain. EnergyTechnol.*, Dec. 2010, pp. 1–6.

[18] G. A. Covic, J. T. Boys, A. M. W. Tam, and J. C. H. Peng, "Self tuning pick-ups for inductive power transfer," in *Proc. IEEE Power Electron.Spec. Conf.*, Jun. 2008, pp. 3489–3494.

[19] S. W. Lee, J. Huh, C. B. Park, N. S. Choi, G. H. Cho, and C. T. Rim, "On-line electric vehicle using inductive power transfer system," in *Proc.IEEE Energy Convers. Congr.Expo.*, Sep. 2010, pp. 1598–1601.

[20] S. W. Lee, J. Huh, C. B. Park, N. S. Choi, G. H. Cho, and C. T. Rim, "On-line electric vehicle using inductive power transfer system," in *Proc.IEEE Energy Convers. Congr.Expo.*, Sep. 2010, pp. 1598–1601.

[21] J. Huh, S. W. Lee, C. B. Park, G. H. Cho, and C. T. Rim, "High performance inductive power transfer system with narrow rail width for on-line electric vehicles," in *Proc. IEEE Energy Convers. Congr.Expo.*, Sep. 2010, pp. 647–651.

[22] Y. Kim, Y. Son, S. Shin, J. Shin, B. Song, S. Lee, G. Jung, and S. Jeon, "Design of a regulator for multi-pick-up systems through using current offsets," in *Proc. IEEE Int. Elect. Veh. Conf.*, Mar. 2012, pp. 1–6.

[23] DimitriosKosmanos and et al. "Route Optimization of Electric Vehicles Based on Dynamic wireless charging" july 2018.