Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 2, No. 1, February : 2023

SOLAR BASED WIRELESS CHARGING STATIONS FOR ELECTRICAL VEHICLE

Mr. M. MAHESH M. Tech, Assistant Professor, Department of ECE, NRI Institute of Technology
N. SRAVANI, J. DHANA LAKSHMI, N. CHIRU DIVYA, N. SRINIVAS B. Tech, Student, Department of ECE, NRI Institute of Technology

ABSTRACT

Electric vehicles are a candidate to be the future of world transportation. The idea of changing fuel charged transportation services to electrically charged systems is a breakthrough for efficient energy harnessing, conservation, and smooth energy transformation. Also, it is an effort to reduce detrimental emissions which have corresponding ramifications on a global scale. This directly impacts the present weather conditions plummeting the effects of global warming. In the current age of advanced technologies, there are many organizations which host the manufacturing of these vehicles. However, charging is a well-known problem for EVs. Therefore, several methods have been proposed to charge EVs. One of the conventional ways is to charge a vehicle at a stop or a “station.” The significant limitations are the time required for charging EVs and shorter traveling distances. Therefore, wireless charging has been proposed. There are several factors which affect the wireless charging. Numerous techniques are developed where the EV is charged based on the electromagnetic induction or inductive power transfer. Even though the passive wireless charging is implemented, the main issue which arises is the placements of wireless charging pads as well as the placement of the charging stations. The factors affecting the charging methods and placements of the charging pads and stations are listed in the form of the parameters. This system is achieved through the affordable inductive coupling between two coils termed as transmitter and receiver coil. In EV charging applications, transmitter coils are buried in the road and receiver coils are placed in the vehicle.

Keywords: *Transformer, solar panel, wireless charging, parking slot, Electric vehicle*

I.INTRODUCTION

The charging system provides a physical wire to transmit energy to the battery which is in the car. Even though it is charging quickly there is inconvenience faced by the user Because there is no availability of appropriate charging cable and even though wired charging is popular, problems with messy wires and safety concerns in wet environment are major drawbacks of this system. These problems can be overcome by charging the battery of the vehicle without wires and this technology is termed as wireless power transfer (WPT). While public charging stations are usually safe for your battery, constantly using Level 3. Fast-charging stations can cause your EV's battery to degrade faster than using Level 1 or Level 2 chargers for the majority of your charges. Your charging cable might have a loose wire, the adapter could have malfunctioned, or even the socket it's plugged into could be failing to transmit the current properly. To rule out a faulty cable, attempt to charge your phone through a different cable, adapter, or power source. 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) 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 these vehicles. 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 to perform a fast charge.

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 (WPTSs). Their deployment has started for the recharge of the batteries that are fitted in grid-detachable equipment. Recharging is executed while the equipment is standing in an on-purpose set but the long- time perspective is the supply of equipment while moving, with the purpose of removing the batteries or at least of reducing their capacity.

II.LITERATURE SURVEY

Wireless charging for electric vehicles, it was evident that vehicle electrification was unavoidable due to environmental and sustainable energy supply concerns. When contrasted with plug-in charging, wireless charging offers numerous advantages. With highways electrified to provide wireless charging, it will lay the groundwork for mass-market adoption of electric vehicles, regardless of battery technology. The report provided a good overview of contemporary EV wireless power charging research in a concise manner. It also included a small-scale experimental model for deeper comprehension of the wireless proposition. The inductive power transmission efficiency was significantly higher than that of the round coil, resulting in a more efficient total wireless power transfer system. Despite the fact that square coils were far more efficient than round coils, their efficiency remained low. To counter this, it was suggested by a study that a larger diameter wire be used, as this would result in a longer coil. A longer coil length could significantly enhance inductance and magnetic field, resulting in a higher transfer efficiency.

The authors asserted that EMF emissions can be significant, especially at high-power transfer levels and misalignment circumstances, and should be kept within the ICNIRP 2010 recommendations, which are more conservative and considered safer. The fundamentals of inductive power transfer and strongly coupled magnetic resonance were discussed, with a focus on maximal power transmission and efficiency. A synopsis of current achievements in wireless EV charging was presented. The most up-to-date solutions for each issue were explored.

Jiang examined safety implications for WPT applications on EVs in a study, because of the broad region of electromagnetic field exposure between the vehicle and the primary coil, as well as the high electrical power involved in this operation, the system must be developed to fulfil the safety standard. In order to satisfy the customer’s expectations, safety must be improved, as well as the efficiency and charging cycle. Electrical shock, electromagnetic field exposure level, and fire danger should all be included in the standard test. Both computational and experimental tools were used to evaluate the near magnetic fields for the EV’s wireless charging system.

III.PROPOSED SYSTEM

Electric vehicles have now hit the road worldwide and are slowly growing in numbers. Apart from environmental benefits electric vehicles have also proven helpful in reducing cost of travel by replacing fuel by electricity which is way cheaper. However electric vehicles have 2 major disadvantages:

1.Long charging time,1-3 hours required for charging

2.Non availability of power for charging stations in off city and remote areas.

In this proposed system, we develop an EV charging system that solves both these problems with a unique innovative solution. This EV charging system delivers following benefits.

1.Wireless charging of vehicles without any wires.

2.No need to stop for charging, vehicle charges while moving

3.Solar power for keeping the charging system going

4.No external power supply needed

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 2, No. 1, February : 2023

5.Coils integrated in road to avoid wear and tear

In this system makes use of a solar panel, battery, transformer, regulator circuitry, copper coils, AC to DC converter, at mega 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.

Block Diagram

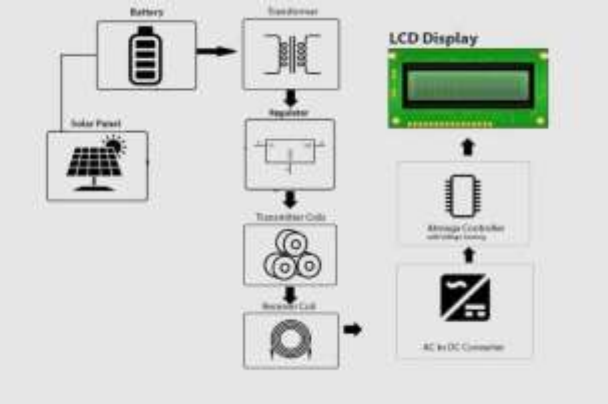

Fig 1: Block diagram of solar based wireless charging stations for EV's

Solar Panel

Solar panel is used to extract the energy from the sunlight and it is used to power the battery through a charge controller.

Fig 2: Solar Panel

Battery

The battery is used to store the energy which is coming from the solar panel. 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.

Transformer

A transformer cannot convert AC to DC or DC to AC. The transformer has the ability to step up or decrease current. A step-up transformer is a transformer that raises the voltage from the primary to the secondary. The voltage is reduced from primary to secondary by the step-down transformer.
The power is converted to AC using transformer and the regulated using regulator circuitry.

Regulator

A voltage regulator is a component of the power supply unit that ensures a steady constant voltage supply through all operational conditions. It regulates voltage during power fluctuations and variations in loads. It can regulate AC as well as DC voltages.

Transmitter Coil & Receiver Coil

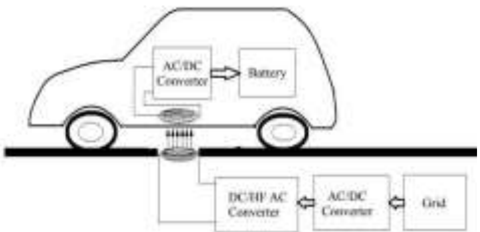

Fig 3: Block diagram of wireless power transfer

This System mainly has two sections, wireless power transmitter & a wireless power receiver sections. The transmitter section of the proposed system consists of a power source and a transmitter coil whereas the receiver section consists of a receiver coil, rectifier and filtering circuit, and a rechargeable battery. The AC power from the transformer is given to the primary coil whichis implanted on the charging station. The flux is radiated out from the primary coil and this flux is linked with the secondary coil which induces current in the secondary coil in the EV. The alternating current induced in the secondary coil is converted to direct current which is then used to charge the battery of the EV. Then we use AC to DC conversion circuitry to convert it back to DC current.

At mega Controller

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

LCD Display

Fig 4: LCD display

Now we also measure the input voltage using an at mega microcontroller 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.

IV. RESULT ANALYSIS

The main purpose of this project "Solar Based Charging Station for Electrical Vehicle" is to get the most energy out of the solar panel by changing the angle of rotation in response to the strength of light falling on it, with this process we can get a lot of energy from the solar panel from different sides of the slope. Depending on the availability of sunlight, the solar panel tilt angle is determined. In addition, the Think speak web server continuously tracks the amount of energy generated by the solar panel and the amount of load used by the electric car charging station. the highest energy from the solar panel is obtained using different moving angles, the amount of energy produced by the solar panel is greater than when the solar panel is placed in a fixed position. An electric car charging station is a place where a line is drawn on every electric car for a charge. These charging channels are sent to the standard separation range to make the public domain easily accessible. Just like ordinary cars like gasoline engines get fuel at a gas station, the charging stations are a place to charge electric cars. As it plays a necessary role in charging electric batteries, it is necessary to monitor its performance within and within the Internet of Things, With the existing system of scarcity lacking.

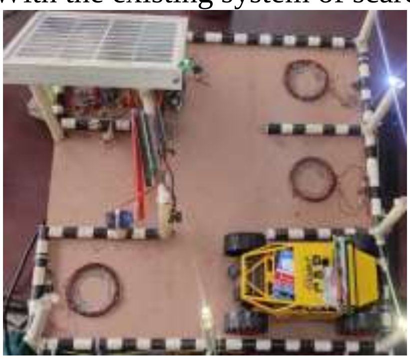

Fig 5: Output of the solar based wireless charging stations for EV's in the Day Time

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 2, No. 1, February : 2023

As shown in the above figure, In the day time we use the solar panel energy. which is extract from the sunlight, to charge the electrical vehicle.

Fig 6: Output of the solar based wireless charging stations for EV’s in the Night Time

As shown in the above figure, In the night time we use battery to charge the electric vehicles. The battery is stored the energy in the day time, which is coming from the solar panel.

Inductive charging technology

Fig 7: The power is transfer through the windings

Inductive wireless charging of electric vehicles can be done using Inductive Power Transfer (IPT). Requirement is to be able to charge a single device quickly and efficiently on a dedicated charging mat so inductive charging is preferred over others. IPT uses alternating magnetic fields as a mode of power transfer from primary coil to secondary coil. Usage of suitable material for primary and secondary coil must be ensured for better power transfer. Alternating field produced links with the on-vehicle pick-up pad, thereby enabling wireless power transfer. In stationary/static charging, parking lots can be upgraded to charging EVs comfortably without handling any charging cable with charge-pads. Road should be constructed that consists of prefabricated concrete modules with cells laid on the ground with a layer of tempered glass that is translucent to light.

V.CONCLUSION AND FUTURE SCOPE

Depletion of Fossil fuels has increased the need for mechanically simpler wireless charging technique for vehicles at rest. Static charging increases the system performance by reducing the loss, compared to dynamic charging. Since the source is electricity, this method of charging is considered to be efficient compared to the fuel-based charging. Wireless charging technique reduces the risk of tripping problem that are caused by plug-in charging. Higher efficiency than plug-in charging for electric vehicles by reducing the hazards caused due to plug-in charging. Ensuring the efficient way of charging in a less cost. Better air quality will be ensured which will lead to less health problems caused by air pollution. High- performance, safe, and cost-effective static electric vehicle charging has the potential to revolutionize road transportation.

One of the problems in electric vehicle is range anxiety which is the fear that a vehicle has insufficient range to reach its destination and would thus strand the vehicle’s occupants. To avoid this problem dynamic wireless charging systems can be installed on the roads so that the Electric Vehicles can be charged while in motion and also a charge monitoring system can be developed for the authorized owner to get the notification about the status of the battery of the vehicle. Furthermore, Inwheel Wireless Charging System (IW-WCS) can be developed to reduce the air gap and coil misalignment issues in the dynamic wireless charging system. This can be done by integrating secondary coils with the wheels of the vehicle. The alignment system can be modifiedby giving the direction about the position of the vehicle to the owner whenever the vehicle is misaligned.

REFERENCES

[1] A. Kur's, A. Karelis, R. Moffatt, J. D. Joannopoulos, P. Fisher,M. Soljačić, Wireless power transfer via strongly coupled magneticresonances, Science 317 (5834) (2007) 83–86. doi:10.1126/science.1143254.

[2] S. Chhawchharia, S. K. Sahoo, M. Balamurugan, S. Sukchai,F. Yanine, Investigation of wireless power transfer applications witha focus on renewable energy, Renewable and Sustainable Energy Reviews 91 (2018) 888–902. doi: https://doi.org/10.1016/j.rser. 2018.04.101.

[3] S. D. Barman, A. W. Reza, N. Kumar, M. E. Karim, A. B. Munir,Wireless powering by magnetic resonant coupling: Recent trends in wireless power transfer system and its applications, Renewable and Sustainable Energy Reviews 51 (2015) 1525–1552. doi:https://doi.org/10.1016/j.rser.2015.07.031.

[4] X. Zhang, Z. Yuan, Q. Yang, Y. Li, J. Zhu, Y. Li, Coil design and efficiency analysis for dynamic wireless charging system for electric vehicles, IEEE Transactions on Magnetics 52 (7) (2016) 1–4. doi: 10.1109/TMAG.2016.2529682.

[5] A. N. Azad, A. Echols, V. A. Kulyukin, R. Zane, Z. Pantic,Analysis, optimization, and demonstration of a vehicular detection system intended for dynamic wireless charging applications, IEEE Transactions on Transportation Electrification 5 (1) (2019) 147–161.doi:10.1109/TTE.2018.2870339.

[6] M. Longo, D. Zaninelli, G. Cipriani, V. Di Dio, R. Miceli, Economic analysis on the use of wired and wireless recharging systems, in: 2017 IEEE International Conference on Environment and ElectricalEngineering and 2017 IEEE Industrial and Commercial PowerSystems Europe (EEEIC / I CPS Europe),2017, pp.1–6. doi: 10.1109/EEEIC.2017.7977704.

[7] F. M. Eltoumi, M. Becherif, A. Djerdir, H. Ramadan, The key issues of electric vehicle charging via hybrid power sources: Techno-economic viability, analysis, and recommendations, Renewable and Sustainable Energy Reviews 138 (2021) 110534. doi:https://doi.org/10.1016/j.rser.2020.110534.

[8] D. M. Vilathgamuwa, J. P. K. Sampath, Wireless Power Transfer (WPT) for Electric Vehicles (EVs)—Present and Future Trends, Springer Singapore, Singapore, 2015, pp. 33–60. doi:10.1007/ 978-981-287-299-9_2.

[9] A. Vallera, P. Nunes, M. Brito, Why we need battery swapping technology, Energy Policy 157 (2021) 112481. doi:https://doi.org/10.1016/j.enpol.2021.112481.

[10] F. Tuchnitz, N. Ebell, J. Schlund, M. Pruckner, Development and evaluation of a smart charging strategy for an electric vehicle fleet based on reinforcement learning, Applied Energy 285 (2021) 116382. doi:https://doi.org/10.1016/j.apenergy.2020.116382

[11] M. Abdolmaleki, N. Masoud, Y. Yin, Vehicle-to-vehicle wireless power transfer: Paving the way toward an electrified transportationsystem, Transportation Research Part C: Emerging Technologies 103 (2019) 261–280. doi:https://doi.org/10.1016/j.trc.2019.04.008.

[12] S. R. Khutwad, S. Gaur, Wireless charging system for electric vehicle, in: 2016 International Conference on Signal Processing, Communication, Power and Embedded System (SCOPES), 2016, pp. 441–445. doi:10.1109/SCOPES.2016.7955869.

[13] R. J. Flores, B. P. Shaffer, J. Brouwer, Electricity costs for an electric vehicle fueling station with level 3 charging, Applied Energy 169 (2016) 813–830. doi:https://doi.org/10.1016/j.apenergy.2016.02.07.

[14] X. Mou, R. Zhao, D. T. Gladwin, Vehicle-to-vehicle charging system fundamental and design comparison, in: 2019 IEEE International Conference on Industrial Technology (ICIT), 2019, pp. 1628–1633. doi:10.1109/ICIT.2019.8755057.

[15] M. Etemadrezaei, 22 - wireless power transfer, in: M. H. Rashid (Ed.), Power Electronics Handbook (Fourth Edition), fourth editionEdition, Butterworth-Heinemann, 2018, pp. 711–722. doi:https: //doi.org/10.1016/B978-0-12-811407-0.00024-6.

[16] M. Molefi, E. D. Markus, A. Abu-Mahfouz, Wireless power transferfor IoT devices-a review, in: 2019 International Multidisciplinary Information Technology and Engineering Conference (IMITEC), IEEE, 2019, pp. 1–8.