iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** XI **Month of publication:** November 2023

DOI: https://doi.org/10.22214/ijraset.2023.56759

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

Development Of Solar Powered Static Wireless Charging System For Electric Vehicles

Rahul G. Chaple[1], Swapnil R. Choudhari[2], Tannu R. Mate[3], Suchita A. Chaudhri[4], Prof. Shital Yende[5]
[1, 2, 3, 4]Student, [5]Project Guide, Department of Electrical Engineering, Suryodaya Collage of Engineering & Technology, Nagpur

Abstract: Electric vehicles have been introduced to the contemporary world, aligning with the increasing integration of new technologies into daily life. Despite the use of electric vehicles, certain limitations persist, including issues such as heating during charging, potential charging depletion, a scarcity of charging stations, and the high installation cost of such stations. Addressing these challenges, this project proposes a wireless electric vehicle charging station with monitoring capabilities. The aims include preventing overcharging, monitoring battery levels, ensuring cost-effectiveness, promoting eco-friendliness, and strategically placing charging stations in urban areas. The project specifically focuses on the design of a solar-powered electric vehicle charging system, offering a solution to the key issues of fuel dependency and environmental pollution. Electric vehicles have gained global traction and are progressively becoming more prevalent. Beyond their environmental advantages, electric vehicles contribute to cost reduction by substituting electricity for fuel, which is a more economical alternative. This project presents an innovative solution for EV charging, eliminating the need for wires, enabling charging while in motion, harnessing solar power to sustain the charging system, and operating without external power supply requirements. The system incorporates components such as a solar panel, battery, transformer, regulator circuitry, copper coils, AC to DC converter, Atmega controller, and LCD display. Through this integration, the system showcases the wireless charging capability for electric vehicles at charging stations. The LCD display provides real-time information on the total cost, eliminating the necessity for halting the vehicle during the charging process. In summary, the project demonstrates the viability of a solar-powered wireless charging system for electric vehicles, presenting a forward-looking approach to integration.
Keywords: Solar Panel, Boost Converter, Battery, Transmitting Coil, Receiving Coill, Arduino uno, Voltage sensor etc.

I. INTRODUCTION

In the realm of transportation, electric vehicles (EVs) emerge as an innovative concept poised to revolutionize the automobile market. The charging process for these vehicles must be carefully managed to ensure the stability of power networks. However, the proliferation of EVs introduces the potential for a substantial energy reservoir within their batteries, influencing the power grid's autonomy. EV interactivity is anticipated to become a pivotal technology in future smart grids. Opting for a wireless EV charger becomes an appealing choice for individuals seeking an electric means of charging their vehicles. This choice gains prominence due to the escalating prices of fossil fuels and a concurrent decline in $CO2$ emissions, rendering electric vehicles economically competitive against traditional counterparts. Historically, limited adoption of electric vehicles stemmed from factors such as high vehicle costs, insufficient fast-charging stations, and a scarcity of all-electric vehicle options. Nonetheless, advancements in electric vehicle technology have enabled them to be powered wholly or partially by electricity, presenting a more sustainable and cost-effective alternative. The streamlined design of electric cars, featuring fewer moving parts and reduced environmental impact, contributes to lower operational expenses compared to traditional gasoline-powered vehicles. This project employs a comprehensive system comprising a solar panel, battery, transformer, regulator circuits, copper coils, AC to DC converter, Atmega controller, IR sensor, voltage sensor, current sensor, and an LCD display to establish an efficient vehicle charging system. Notably, the system eliminates the need for vehicle stops during charging, allowing electric vehicles to be charged while in motion. A charge controller facilitates the connection between the battery and the solar panel, storing DC electricity in the battery. To transmit this stored power, a transformer is employed to convert DC to AC power efficiently.

II. PROBLEM STATEMENT

1) In the realm of transportation, electric vehicles (EVs) embody an innovative concept poised to reshape the automobile market. Forecasts anticipate electric vehicles (EVs) to progressively dominate the automotive landscape in the foreseeable future.
2) The charging process for electric vehicles (EVs) requires careful regulation to maintain the integrity of power networks.
3) Despite these considerations, the proliferation of electric vehicles (EVs) introduces a substantial energy reservoir within batteries, potentially yielding the opposite effect.

4) EV interactivity is poised to become a pivotal technology in future smart grids, bolstering the autonomy of the power grid.
5) Challenges such as extended charging times of 5-6 hours and the absence of charging stations in off-city and remote areas further compound the adoption of electric vehicles.

III. OBJECTIVE

1) Formulating a solar-powered wireless electric vehicle charging system design.
2) Constructing a model for wirelessly charging electric vehicles using renewable energy, coupled with the primary power supply.
3) Enhancing power efficiency through external sources.
4) Implementing a wireless power transmission and time-saving system.
5) Conducting thorough testing of output results post the prototype model's implementation.
6) Crafting a research paper and thesis based on the obtained results and analysis from the developed model.

IV. LITERATURE SURVEY

With a decline in carbon dioxide emissions and a surge in fossil fuel costs, electric vehicles have gained a competitive edge over traditional internal combustion engine vehicles. Despite these advancements, the widespread adoption of electric vehicles (EVs) has been hindered by the high initial vehicle costs. Challenges persist, including a scarcity of fast-charging stations and limited availability of all-electric vehicle options. Electric vehicles come in two variants: those solely powered by electric energy and those partially reliant on electric power. Beyond their economic advantages and minimal environmental impact, electric vehicles significantly reduce or eliminate reliance on fossil fuels.

Foreseeing electric vehicles as the predominant mode of transportation in the future, efforts are underway to enhance the efficiency of charging stations. A common deterrent to acquiring electric vehicles is the lack of charging infrastructure. This study introduces a portable EV charger designed to reduce charging times using renewable energy. Employing a hybrid power system, this approach addresses the unique needs of long-distance EV drivers who face challenges in finding places to recharge their vehicles along major highways.

1) *Yanjie Guo et. al.. 2018,* In this paper, The analysis of compensation network interoperability in electric vehicle (EV) wireless charging systems (WCS) is conducted, accompanied by a method for evaluating compensation network interoperability. Initially, the reflected impedances of WCS secondary sides are computed based on two common compensation networks: series capacitor (SC) compensation and inductor-capacitor-capacitor (LCC) compensation. Subsequently, a method for interoperability evaluation is introduced, taking into account minimal changes in system performance. Finally, an EV wireless charging prototype is constructed, and experiments and simulations are carried out to validate both the analysis and the proposed evaluation method. The results indicate that SC and LCC compensation networks exhibit effective interoperability under conditions where the equivalent load resistance Re closely aligns with the optimal coil load resistance Ropt.
2) *Zou Danping et al. 2019,* This paper presents a billing strategy for charging fees, aiming to calculate electricity fees and service charges while taking into account power loss, construction costs, and the balance of the number of electric vehicles (EVs) on the charging road. Through experiments, it is demonstrated that the metering and charging system accurately computes the charging fees for EVs on the wireless charging road. To address the need for precise metering and rapid charging in dynamic wireless charging scenarios for electric vehicles, the paper puts forth a metering and charging system. This system comprises identification equipment, charging software, power meters, on-board units, and a charging control unit.
3) *Feng Wen, et al. 2019,* In this paper, It develop a model for a Wireless Power Transfer (WPT) charging system for Electric Vehicles (EVs) and investigate its impact on the power grid under resonant, capacitive, and inductive conditions. Fast Fourier Transform (FFT) is applied to the voltage waveforms on the grid side to assess harmonic pollution at varying power levels during system operation. With the government's push for electric vehicle (EV) adoption, the EV industry is poised for rapid growth, leading to a significant boost in the deployment of electric vehicle charging stations and wireless charging devices. The charging behavior of a large fleet of electric vehicles has the potential to introduce harmonic pollution to the power grid due to wireless charging.
4) *Palwasha W. Shaikh et al. 2021,* The study introduces a system where charging requests from Electric Vehicle (EV) and Autonomous Electric Vehicle (AEV) users are efficiently managed by dynamically allocating the requests across three distinct types of charging equipment. The fulfillment of these requests is carried out, and subsequent billing occurs in a private and secure manner through two proposed payment schemes involving encrypted virtual currency. The system, independent of

hardware, is capable of identifying misalignment issues with connected vehicles on wireless charging pads and addressing speed-related errors in dynamic wireless charging systems, while also preventing free-riding. In simulation, the presented system demonstrates trip planning capabilities with minimal waiting times, travel costs, and battery consumption per vehicle trip, achieving an efficiency rate of 90.25% in charge delivery.

5) *Chen Mingming et. al. 2023*, This paper outlines a solar-powered dynamic electric car charging system designed to reduce pollutants and fuel consumption. The increasing popularity of electric vehicles is driven by the escalating costs of gasoline. The current presence of electric vehicles on roads is gradually growing, with demonstrated cost advantages over traditional petrol vehicles. To address charging system challenges, an innovative electric charging system has been devised, capable of charging a moving electric car without the need for wires, external power sources, or vehicle stops. The system components include a battery, transformer, Atmega controller, LCD display, regulatory circuit, solar panel, copper coils, and AC to DC converters. This comprehensive approach elucidates the process of charging an electric car while it is in motion, eliminating the necessity for frequent stops. The system achieves this by insulating the copper coil embedded in the road.
6) *Virendra Kumar Chaudhari et. al. 2023,* In this paper, we present a successfully designed solar-based dynamic electric vehicle charging system operating on the principle of mutual induction. When the electric vehicle requires charging, it moves to the designated electric vehicle lane. Pre-installed infrared sensors detect the presence of the electric vehicle and activate the power supply to the coil. This system is environmentally friendly, pollution-free, and notably wireless. It contributes to the reduction of battery and electric vehicle costs. Given the diminishing availability of coal, petrol, diesel, and other natural gases, coupled with the increasing prevalence of electric vehicles and the associated charging challenges, various countries are exploring dynamic wireless charging for electric vehicles using renewable energy resources.

V. RESEARCH METHODOLOGY

The proposed vehicle is characterized by its simplicity and ease of construction compared to traditional gas-powered cars. The electric car design includes two motors and their controllers, a reversing circuit, a battery pack, a solar photovoltaic (PV) module with a charge controller, and a speed controller. Both controllers share a common accelerator for activation. Brake switches halt the motors when brakes are applied, and turning the car in the opposite direction of a motor results in its shutdown, achieved by switching two phases and two control wires while the vehicle is in motion. A conveniently located reverse button is incorporated on the steering column.

To address the challenges of cumbersome cords, wireless power transmission (WPT) has been facilitated through magnetic resonance technology. WPT utilizes the same fundamental principle as inductive power transfer, which has undergone refinement over the past three decades. Notably, WPT has seen remarkable advancements, with power transfer capacities ranging from milliwatts to kilowatts and the power transfer distance increasing from a few millimeters to several hundred millimeters, achieving higher load efficiency. These advancements make WPT increasingly appealing for both stationary and dynamic electric vehicle (EV) charging applications.

The technologies discussed in this context fall within the domain of Wireless Power Transmission (WPT). The implementation of WPT is seen as a solution to the limitations of range, high costs, and inconvenient charging associated with EVs. As EVs have reached critical mass, with battery technology no longer a limiting factor, the anticipation is that researchers will be motivated by state-of-the-art results to further develop WPT and EV technologies.

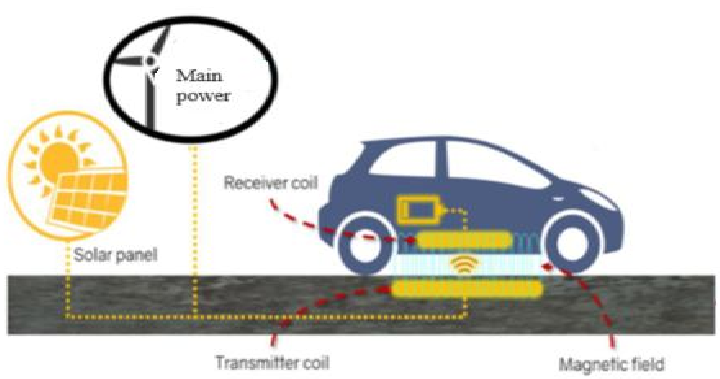

Fig.1. Overall Block Diagram of the proposed system

The project aims to implement a system for wirelessly charging electric vehicles using solar power. The project is divided into two parts: the optimization of existing solar power in the first section and the design of a wireless power transmission system based on inductively coupled power transmission technology, utilizing the optimized solar power as input, in the second section.

VI. BLOCK DIAGRAM

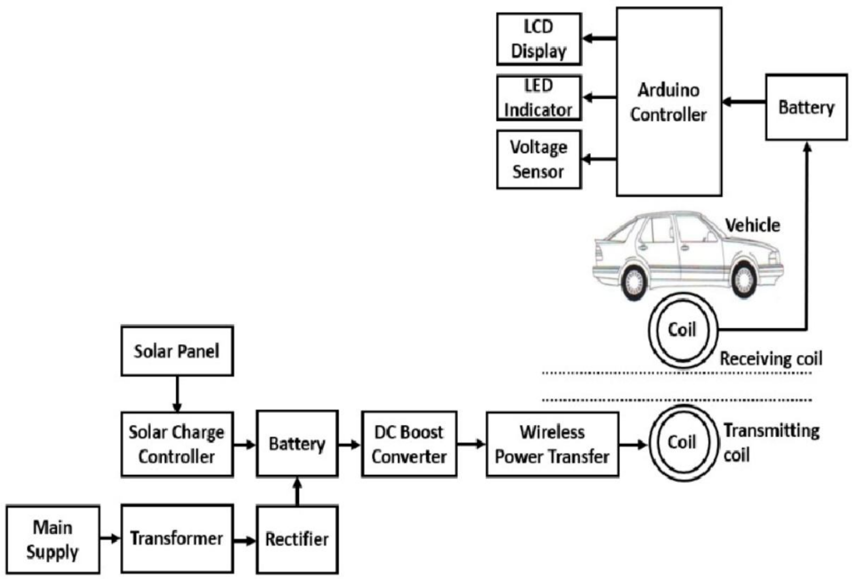

Fig.2. Block Diagram

VII. WORKING

The solar panel charges the transmitter coils, which, in turn, charge the battery, with the stored energy regulated. Initially, solar energy is converted into electricity by the solar panel, passing through the solar charge controller and sent to the battery for charging. Simultaneously, an external AC power supply unit is employed to charge the battery at the transmitter section, i.e., at the charging station. To prevent energy wastage, the primary and secondary coils of a transformer are linked through a magnetic field directed by the transformer's core. As the net magnetic flux from the stimulated spin system oscillates, the receiver coil records an induced electric current, wirelessly charging it.

The Atmega controller is powered by the DC power stored in the vehicle's battery unit. The voltage sensor sends readings of the current voltage status to the controller. The live voltage status is displayed on the LCD screen attached to the controller. The system can display the vehicle's initials on the integrated LCD screen, illustrating the functionality of the system.

VIII. CONCLUSION

Electrical vehicles are the means of transportation of the future because they can maximize the efficiency of charging stations. There will be a major role for electric vehicle charging stations. Increasing EV demand in the market requires addressing the fundamental barrier to EV adoption: a dearth of public charging stations. We looked at the portable EV charger that uses renewable energy to speed up the charging process. The work presented herein presents a novel service to long-distance electric vehicle travelers through the use of a hybrid power system for a vehicle battery charging station. Unfortunately, there is a severe lack of convenient charging infrastructure for drivers of electric vehicles along interstates and highways. The wireless EV charger is the best option for charging their electric automobiles.

REFERENCES

[1] Yanjie Guo, Yuwang Zhang, Bingrong Yan, Ke Wang, Zhenjun Zhang, Lifang Wang, "Analysis of Compensation Network Interoperability in Wireless Charging Systems for Electric Vehicles," presented at the International Power Electronics and Application Conference and Exposition (PEAC), IEEE, 2018.

[2] Zou Danping, Liu Juan, Chen Yuchun, Liu Yuhang, Chu Zhongjian, "Electric Energy Metering and Charging System Research for Dynamic Wireless Charging of Electric Vehicles," presented at the 4th International Conference on Intelligent Transportation Engineering (ICITE), IEEE, 2019.

[3] Feng Wen, Qiang Li, Li Liu, Rui Li, Tao Wu, "Study on the Harmonic Influence of Wireless Charging Systems for Electric Vehicles on Power Grids," presented at the Innovative Smart Grid Technologies - Asia (ISGT Asia), IEEE, 2019.

[4] Palwasha W. Shaikh, Hussein T. Mouftah, "Connected and Autonomous Electric Vehicles Charging Reservation and Trip Planning System," presented at the International Wireless Communications and Mobile Computing (IWCMC), IEEE, 2021.
[5] Bao Jin, Chen Mingming, Li Jun, "Electric Energy Metering in Wireless Charging Systems and Its Impact on Operation," presented at the 6th International Conference on Electronics Technology (ICET), IEEE, 2023.
[6] Virendra Kumar Chaudhari, Kirti Nishad, Kirti Patel, Sakshi Vishwakarma, Atul Sharma, Vijay Pratap Singh, "Solar-Based Wireless Dynamic Electric Vehicle Charging System," presented at the International Conference on IoT, Communication, and Automation Technology (ICICAT), IEEE, 2023.
[7] Chan C. C., Alain Bouscayrol, Keyu Chen, "Electric, Hybrid, and Fuel-Cell Vehicles: Architectures and Modeling," IEEE Transactions on Vehicular Technology, Vol. 59, No. 2, pp. 589-598, February 2010.
[8] Keeling N.A., Boys J.T., Covic G.A., "A Unity-Power-Factor IPT Pickup for High-Power Applications," IEEE Transactions on Industrial Electronics, 57(2), pp. 744 – 751, 2010.
[9] Ranjeet Singh1, Manoj Kumar Gaur2, Chandra Shekhar Malvi3, "A Study and Design-Based Simulation of a Hybrid Solar Car," presented at the International Conference on Emerging Trends in Engineering, Technology, and Science (ICETETS), IEEE, 2013.
[10] Chwei-SenWang, Stielau O.H., Covic G.A., "Design Considerations for a Contactless Electric Vehicle Battery Charger," IEEE Transactions on Industrial Electronics, 52(5), pp. 1308 - 1314, 2005.
[11] Chan C.C., "The State of the Art of Electric, Hybrid, and Fuel Cell Vehicles," Proceedings of the IEEE, 95(4), pp. 704 - 718, 2007.
[12] Emadi A., Young Joo Lee, K Rajashekara, "Power Electronics and Motor Drives in Electric, Hybrid Electric, and Plug-In Hybrid Electric Vehicles," IEEE Transactions on Industrial Electronics, Volume 55, Issue 6, pp. 2237-2245, June 2008.