



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 5, May 2025

Smart EV Charging Station with On-Grid Green Power & Wireless Charging

Dr. Zuhaib Baig¹, Mohammed Aiyen Ur Rahaman², Tehreem Suman³, Namratha Y H⁴, Chandan V⁵

Assistant Professor, Dept. of EEE, Vidya Vikas Institute of Technology, Mysuru, Karnataka, India¹

UG Students, Dept. of EEE, Vidya Vikas Institute of Technology, Mysuru, Karnataka, India^{2,3,4,5}

ABSTRACT: This project proposes a Smart Electric Vehicle (EV) Charging Station integrating renewable energy and wireless charging. Solar and wind sources are connected to the grid to ensure continuous, eco-friendly power supply. Real-time energy management optimizes charging based on availability and demand. Wireless inductive charging allows cable-free operation for enhanced convenience. A smart interface offers live updates on charging status, energy use, and billing. Multiple payment options and RFID/mobile authentication are supported. Load balancing reduces peak-hour grid strain. Excess green energy is stored for later use, increasing efficiency. IoT integration enables remote monitoring and predictive maintenance. The system promotes clean mobility through a sustainable and user-friendly design.

KEY WORDS: Smart EV Charging, Wireless Power Transfer, Renewable Energy Integration, IoT-based Monitoring, Load Management, RFID Authentication, Vehicle-to-Grid (V2G), Sustainable Transportation

I. INTRODUCTION

The rapid growth of electric vehicles (EVs) has created a pressing need for efficient, scalable, and environmentally friendly charging infrastructure. Traditional EV charging methods often rely heavily on grid power, which may not always be derived from sustainable sources and can contribute to increased load during peak demand periods. To address these limitations, the integration of renewable energy and smart technologies into EV charging stations is gaining importance. This paper introduces a smart EV charging station that combines on-grid green energy—sourced from solar and wind—with wireless charging capabilities. The proposed system ensures continuous power availability by intelligently managing inputs from renewable sources and the main grid. Wireless charging, based on inductive power transfer, simplifies the user experience by eliminating the need for physical connectors. The station features intelligent control, real-time monitoring, and user-friendly interfaces, making it suitable for modern urban environments. By combining clean energy, advanced automation, and convenience, this solution supports sustainable transportation and smart city development. production, storage and technical limitations of fuel. Traditional transportation sector is using fossil fuel with

II. PROBLEM STATEMENT

The growing adoption of electric vehicles (EVs) has intensified the demand for efficient, scalable, and eco-friendly charging infrastructure. However, conventional EV charging stations heavily depend on grid electricity, much of which is still generated from non-renewable sources. This reliance not only limits sustainability but also contributes to grid overload during peak hours. Moreover, traditional wired charging systems pose challenges in terms of user convenience, safety, and maintenance. The lack of real-time monitoring, secure access control, and integration with renewable energy sources further hampers the development of intelligent and sustainable charging solutions. There is a critical need for a smart, hybrid charging station that leverages renewable energy, wireless charging, and modern technologies like IoT and RFID to offer a secure, efficient, and environmentally responsible alternative to current EV charging methods.

III. METHODOLOGY

This project presents a smart EV charging system that integrates solar and wind energy to support clean and efficient vehicle charging. A 12V, 10W solar panel and a windmill generator are used to harvest renewable energy, which is

stored in a 12V, 10Ah battery. An XL6009 DC boost converter ensures stable charging, while an inverter converts stored DC power to AC for EV compatibility. The system includes both DC fast wired charging and wireless charging capabilities. Wireless charging is enabled via inductive transfer, secured through RFID-based authentication. Users can initiate charging by scanning an RFID card, enhancing security and ease of use. In cases of low renewable input, the system can draw power from the grid, ensuring uninterrupted operation. This hybrid setup promotes renewable energy use, user convenience, and reliable EV charging infrastructure.

The IoT-based control allows remote monitoring and system diagnostics. Energy usage data and charging status are displayed in real-time through a user interface. This enhances system transparency and operational efficiency. By integrating multiple power sources and smart features, the design offers a scalable model for sustainable EV charging. It addresses key challenges in modern electric mobility with an emphasis on automation, flexibility, and environmental impact.

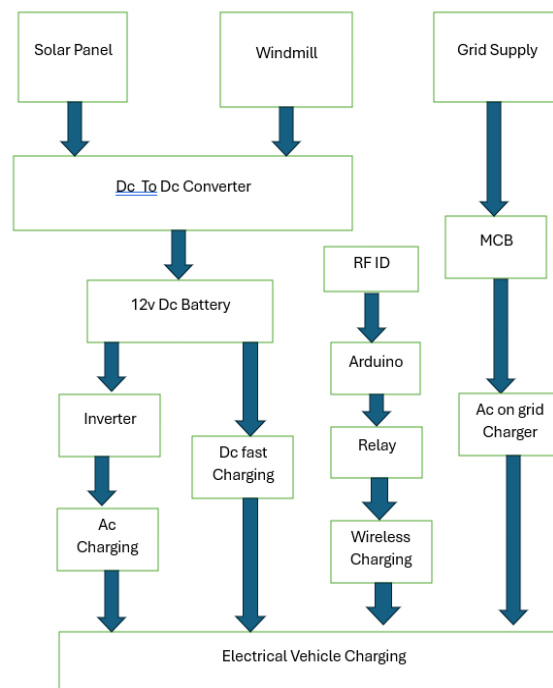


Fig 1: Block daigram

V. SOFTWARE REQUIREMENTS:

The system uses Arduino IDE with C/C++ for programming the microcontroller. RFID authentication is handled using the MFRC522 library. Real-time monitoring and control are enabled via serial communication or IoT platforms. The software controls relay switching, buzzer alerts, and user validation securely.

VI. CONCLUSION

The integration of renewable energy with smart EV charging infrastructure offers a sustainable and forward-looking solution for modern transportation needs. By combining solar and wind power with wireless charging and grid connectivity, the proposed system enhances energy efficiency, reduces carbon emissions, and improves user convenience. Despite challenges such as weather variability and setup costs, the long-term benefits in sustainability and energy independence are significant. Smart features like real-time monitoring, load management, and RFID-based access ensure secure and optimized energy use. As EV adoption continues to rise, such intelligent, green charging

systems will be essential for building resilient and eco-friendly urban mobility networks. Continued innovation and collaboration will drive the advancement of cleaner, smarter transportation infrastructure globally.

REFERENCES

1. S. Habib, M. Kamran, and M. Rashid, "Renewable Energy and Smart Grid Integration for EV Charging," 2018.
2. M. Karpouzis, P. Georgiadis, et al., "Smart Charging and Demand Response for EVs," 2021.
3. J. Zhang, M. Li, and W. Huang, "Wireless Power Transfer for EVs: A Comprehensive Review," 2022.
4. S. Sinha, A. Agarwal, and P. Kumar, "Integration of Solar Energy with EV Charging Stations," 2022.
5. Y. Wu, Z. Jiang, and Y. Zheng, "Blockchain-based Smart Charging for EVs," 2022.
6. X. Chen, W. Lin, and H. Wang, "Impact of Smart Charging on Power Distribution Networks," 2023.
7. Y. Bao, C. Lee, and H. Cheng, "Wireless EV Charging and Charging Efficiency," 2023.
8. R. Zhao, X. Li, and Y. Yang, "Optimal EV Charging with Renewable Energy Integration," 2023.
9. L. Zhang, Q. Wang, and J. Liu, "EV Charging Optimization with On-Grid and Off-Grid Systems," 2023.
10. S. Rahman, et al., "Smart Electric Vehicle Charging Systems: A Review," IEEE Transactions on Industrial Informatics, vol. 18, no. 4, pp. 2022-2033, 2022.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details