SMART EV CHARGING SYSTEM

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ABSTRACT: In today's world people have shifted their usage from fuel based vehicles to electric vehicles. A smart EV charging system is connected and intelligent network for electric vehicle charging that uses data to optimize energy use based on electricity prices, grid conditions and driver needs. It automates the charging process allowing users to simply set a desired departure time.It optimize charging speed and energy use based on user needs, tariff plans, and available power. Also it supports the transition to a greener transportation system by reducing the environmental impact if increased EV adoption. This is a miniature model of smart EV charging system that uses components like Arduino nano, wireless charging module for charging the vehicle.

The history of EV cars dates back to the 19th century with early experiments by inventors like Robert Anderson. Electric cars gained popularity in the early 1900s but were surpassed by gasoline-powered cars due to the mass production of the affordable Ford Model T. Renewed interest emerged in the 1970s during oil crises, and later, in the 1990s, environmental regulations and technological advancements like lithium-ion batteries spurred a revival, most notably with the introduction of the Tesla Roadster in 2008.

The core principles of an EV charging station using an Arduino focus on automation, safety, and control of the power transfer process. The Arduino acts as the central control unit, managing components such as sensors and relays to ensure efficient and safe charging, particularly in the context of low-power or prototype systems.

I.INTRODUCTION

An EV charging station is a facility that supplies electric energy to recharge the batteries of plug-in electric vehicles (EVs). Also called an electric recharging point, charging point, or EVSE (electric vehicle supply equipment), it provides power through a cable and connector that plugs into the vehicle's charging port. These stations are essential infrastructure for EV adoption, found at homes, workplaces, and public locations like parking lots and malls.

An Electric Vehicle (EV) wireless charging system uses electromagnetic induction to transfer power without a physical cable, allowing EVs to charge simply by parking over a ground pad. The system involves a charging pad on the ground and a receiver coil on the EV, which are activated when a vehicle parks correctly, transferring energy from the grid to the battery. These systems come in two main types: stationary, where charging occurs while parked, and dynamic, where EVs can charge while in motion from infrastructure embedded in the road.

Automatic vehicle or automobiles are out most important for transportation of people as well as good for the society . gasoline –fed vehicles produces lot of pollutants which are required to be controlled not only for preserving the fossile fuels but also for saving earth from pollution created by green house gases and other toxic materials.

The electric vehicle which runs with electrical power instead of fossil fuels is an alternative to gasoline vehicles. The ev batteries which works as electrical power storage unit in EV's are coupled with the charging stations.

II.LITERATURE REVIEW

EV charging system are essential for future autonomous vehicles and robotic parking , as the car can park and charge itself without human intervention. A study on trends and developments in electric vehicles charging technologies was conducted by S. Hemavati and A.Shinisha. The paper reviews current and advanced EV charging technologies, including smart, fast, wireless charging and renewable-integrated systems. Government policies and future technological innovations are key to accelerating large-scale EV adoption in India. The charging capability is a crucial design feature for electric vehicle battery packs to address range anxiety and meet customer expectations.[1]

Electric vehicle charging choices: modelling and implications for smart charging services. Nicolo Diana ,Aruna Shivkumar and John W.Polak explained how smart charging helps manage EV demand and support renewable energy.Drivers' charging preferences shape available flexibility.Accurate models and incentives are needed for effective charging strategies. It concludes that recognising this heterogeneity enables better policy design and targeted incentives, and that future work should validate these findings with larger samples and revealed-preference data.[2]

Jae Hyun Lee et.al.'s study investigates where people can charge it at home, at work, or at public location. Plug-in-electric vehicles (PEVs), which include Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) are being adopted rapidly as an alternative to internal combustion engine (ICE) vehicles. They have a smaller battery pack (eg. 8kWh to 20kwh) compared to a BEV. In contrast to ICE vehicles, PEVs can be refueled (charged) anywhere if an electrical outlet is available. [3]

V.Ramakrishnan et al., "A Comprehensive Review on Efficiency Enhancement of Wireless Charging System for the electrical vehicles applications".

This paper concludes that wireless power transfer is viable and desirable solution for recharging EV batteries, due to its safety, low maintenance and dependability. The study analyzes design elements to enhance efficiency and highlights existing gaps , providing roadmap for creating more efficient WPT system to support the expanding EV industry.[4]

.Smart electric vehicle charging system: Joao C.Ferreira, Vitor Monteiro, Joao L. Afonso, Alberto Silva Member ,IEEE The paper proposes a smart system to manage EV charging efficiently. It includes a mobile app to help drivers with charging decisions. It uses V2G technology to connect EVs and renewable energy to smart grids. The paper introduces a smart EV charging system using V2G technology to connect EVs and renewable energy with Smart Grids. It also considers modern electricity markets to optimize buying and selling energy. The goal is to make EV charging more efficient and intelligent.[5]

III. METHODOLOGY

The wireless power transfer system is designed using a transmitter coil on the charging pad and a receiver coil mounted on the EV. An AC power supply is converted to high-frequency AC using an inverter to enable efficient inductive coupling between the coils. Power is transferred wirelessly through magnetic fields, and the EV-side receiver coil rectifies and regulates it to charge the battery. A microcontroller monitors parameters like coil alignment, charging current, voltage, and efficiency. Sensors are used to detect vehicle presence and enable safe, automatic charging. The system is tested for charging performance, safety, misalignment tolerance, and overall power transfer efficiency.[12]

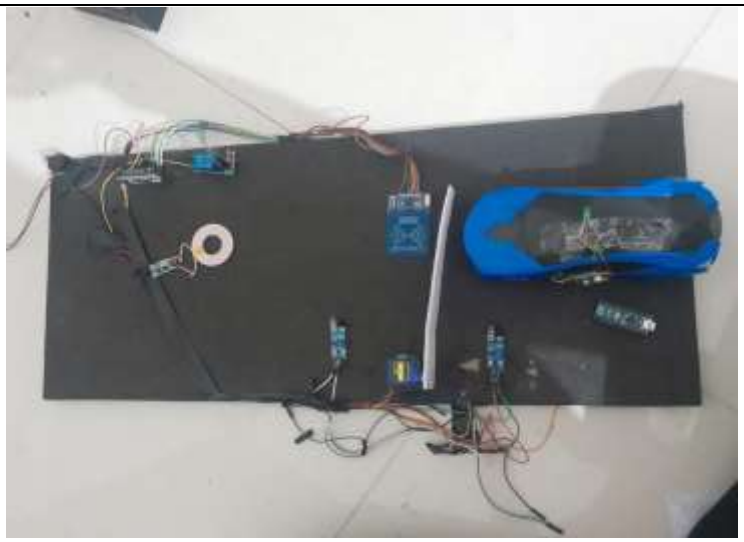

Fig 1 Working Model

Working principle

Higher-power EV charging stations work by converting AC power to DC power, which is then delivered directly to the vehicle's battery, bypassing the onboard charger for faster charging. This is known as DC fast charging (Level 3), and it differs from slower Level 1 and 2 chargers that use AC power which is converted to DC by the car's internal charger. The power output of these stations is much higher, often 50 kW and above, and requires a robust three-phase grid connection.

Arduino boards are generally not used in high-level commercial EV charging stations due to limitations in processing power, memory, safety certifications, and industrial-grade reliability. They are excellent for low-cost prototyping and educational projects but cannot meet the stringent demands of high-power, safety-critical industrial applications. For wireless charging prototypes (based on electromagnetic induction), the Arduino controls the activation of the transmitter coil to induce current in the receiver coil on the vehicle. The system should automatically detect the presence of an EV, initiate charging, and stop when complete or the vehicle leaves. Sensors (like Hall or ultrasonic sensors) provide input to the Arduino for vehicle detection, and the Arduino's programming manages the workflow.[11]

VI. CONCLUSION AND FUTURE SCOPE

The development of wireless charging technology is progressing, with new standards enabling powerful wireless charging for both passenger and heavy-duty vehicles. future of electric vehicles (EVs) in India is bright, driven by ambitious government targets, policy support, and technological advancements. The country aims for 30% of new private cars, 70% of commercial vehicles, 40% of buses, and 80% of two- and three-wheelers to be electric by 2030. Key drivers include a push for domestic manufacturing, expanding charging infrastructure, and advancements in battery technology.

REFERENCES

[1] J. C. Ferreira, V. Monteiro, J. L. Afonso and A. Silva, "Smart electric vehicle charging system," 2011 IEEE Intelligent Vehicles Symposium (IV), Baden-Baden, Germany, 2011, pp. 758-763, doi: 10.1109/IVS.2011.5940579.

[2] M. Rozman et al., "Smart Wireless Power Transmission System for Autonomous EV Charging," in IEEE Access, vol. 7, pp. 112240-112248, 2019, doi: 10.1109/ACCESS.2019.2912931

[3] A. Rajalingam, D. N. A, S. Sathya, J. E. Krishnankutty, A. Y and J. R. Pagunuran, "The Future of EV: Real-Time Development of an Intelligent Wireless Charging System for Electric Vehicles," 2024 1st International Conference on Cognitive, Green and Ubiquitous Computing (IC-CGU), Bhubaneswar, India, 2024, pp. 1-7, doi: 10.1109/IC-CGU58078.2024.10530791.

[4] A. Sultanbek, A. Khassenov, Y. Kanapyanov, M. Kenzhegaliyeva and M. Bagheri, "Intelligent wireless charging station for electric vehicles," 2017 International Siberian Conference on Control and Communications (SIBCON), Astana, Kazakhstan, 2017, pp. 1-6, doi: 10.1109/SIBCON.2017.7998497.

[5]S. Hemavathi, A. Shinisha,A study on trends and developments in electric vehicle charging technologies, Journal of Energy Storage,Volume 52, Part C,2022,105013,ISSN 2352-152X

[6]NicolÃ² Daina, Aruna Sivakumar, John W. Polak,Electric vehicle charging choices: Modelling and implications for smart charging services,Transportation Research Part C: Emerging Technologies, Volume 81,2017,Pages 36-56,ISSN 0968-090X

[7]Jae Hyun Lee, Debapriya Chakraborty, Scott J. Hardman, Gil Tal,Exploring electric vehicle charging patterns: Mixed usage of charging infrastructure,Transportation Research Part D: Transport and Environment,Volume 79,2020,102249,ISSN 1361-9209

[8]V. Ramakrishnan et al., "A Comprehensive Review on Efficiency Enhancement of Wireless Charging System for the Electric Vehicles Applications," in IEEE Access, vol. 12, pp. 46967-46994, 2024, doi:

[9]João C. Ferreira, V. Monteiro, João L. Afonso, “Smart Electric Vehicle Charging System”, IEEE Intelligent Vehicles Symposium (IV), Baden-Baden Germany, pp. 758-763, 5-9 June, 2011, ISBN: 978-1-4577-0890-9, DOI: 10.1109/IVS.2011.5940579

[10]C. Liu, C. Jiang and C. Qiu, "Overview of coil designs for wireless charging of electric vehicle," 2017 IEEE PELS Workshop on Emerging Technologies: Wireless Power Transfer (WoW), Chongqing, China, 2017, pp. 1-6, doi: 10.1109/WoW.2017.7959389

[11] Sushil Khairnar and Deep Bodra. “Recommendation Engine for Amazon Magazine Subscriptions”. International Journal of Advanced Computer Science and Applications (ijacsa) 16.7 (2025). http://dx.doi.org/10.14569/IJACSA.2025.0160796

[12]Sushil Khairnar, Deep Bodra . Analysis and Evaluation of Modern Lightweight Cryptographic Algorithms: Standards, Hardware Implementation, and Security Considerations. International Journal of Computer Applications. 187, 37 (Sep 2025), 10-15. DOI=10.5120/ijca2025925634

[13] Khairnar, S., & Bodra, D. . (2025). A Data-Driven Approach to Air Traffic Delay Prediction and Sentiment Evaluation. International Journal of Basic and Applied Sciences, 14(4), 184-193. https://doi.org/10.14419/cdx7kx09

[14] Sushil Khairnar and Deep Bodra. “Recommendation Engine for Amazon Magazine Subscriptions”. International Journal of Advanced Computer Science and Applications (ijacsa) 16.7 (2025). http://dx.doi.org/10.14569/IJACSA.2025.0160796

[15] Sushil Khairnar. "Application of Blockchain Frameworks for Decentralized Identity and Access Management of IoT Devices". International Journal of Advanced Computer Science and Applications (IJACSA) 16.6 (2025). http://dx.doi.org/10.14569/IJACSA.2025.0160604

[16] Poonam Musmade, S. M. Khairnar, Sachin Rajas, A GRAPH THEORY–BASED APPROACH TO TRAFFIC FLOW MANAGEMENT , 2025, *International Journal of Engineering Sciences and Advanced Technology*, 25(12), Page 255-258, ISSN No: 2250-3676.