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Revolutionizing Electric Vehicle Charging with WPT Technology

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A B S T R A C T

This research endeavors to develop a dynamic wireless charging device for electric powered cars, permitting in-movement charging via a network of roadway-embedded copper coils utilizing magnetic resonance-primarily based WI-FI strength transfer technology. The designed system achieves high performance in various situations, obviating the necessity for conventional charging stations. A novel innovation inside this device comprises the integration of square coils that beautify energy switch efficiency via progressed flux linkage, alignment tolerance, and magnetic discipline uniformity. Furthermore, this design includes photovoltaic additives to harness renewable energy, thereby decreasing the reliance on fossil fuels and promoting sustainable transportation. The proposed infrastructure enables seamless integration with present avenue structures, thereby presenting a practical solution to increase the range of electric motors and alleviate range tension. Ultimately, this challenge pursues revolutionisation of EV charging infrastructure by way of permitting seamless on-board charging, thereby encouraging the wider adoption of electric motors and contributing to a extra sustainable destiny.

Keywords: Advanced wireless charging structures, electric powered car innovation, wirelessly transferring electricity, coil era, efficiency of electricity transfer, square coil designs, linking magnetic fields, magnetic discipline consistency, magnetic subject loss, electromagnetic disturbances, solar power panels, green strength resources, environmentally friendly transportation, charging systems infrastructure, integrating charging into roadways, addressing riding distance worries, promoting electric vehicle adoption, securing a sustainable future.

1. Introduction

Substantial advancements in electric powered vehicle the improvement of electrical cars (EVs) in response to the developing demand for green, environmentally pleasant transportation structures. However, enforcing the logistics of charging these cars on a massive scale persists as a tremendous undertaking. The traditional, stationary charging structures gift certain drawbacks related to person comfort and large-scale applicability. In contrast, dynamic wi-fi charging structures have emerged as a groundbreaking innovation, permitting electric powered motors to recharge on the flow. This capability drastically reduces dependency on precise charging points and enhances the operational efficiency of EVs.

A novel wi-fi electric powered car charging gadget has been designed, which employs rectangular coils to optimize power transfer efficiency. Notably, the incorporation of sun energy allows scalable strength provisions. The adoption of square coils addresses the constraints inherent in traditional circular coil structures, which frequently showcase compromised performance and stability because of misalignment issues, particularly in excessive-velocity programs. However, while circular coils own extra resistance to misalignment and advanced power transfer skills, their blessings are predominantly glaring in static scenarios, instead of continuous reciprocating procedures. This paper proposes a gadget leveraging the characteristics of square coils to obtain heightened performance and balance in dynamic WI-FI charging, thereby resolving the shortcomings of previous coil designs.

The versatility of the proposed gadget is improved via the integration of sun electricity as a primary power source inside the wireless charging infrastructure. This adoption yields an self sustaining and self-enough power answer, thereby minimizing reliance on conventional energy grid systems and ultimately reducing carbon emissions. The synergy among renewable energy resources and dynamic wi-fi charging represents a vast advancement toward the development of eco-friendly mobility systems. Moreover, its utility in urban and toll road settings is especially noteworthy, as it has the capability to considerably augment the operational variety of electrical vehicles and reduce the necessity for on-board battery capacities. Consequently, the implementation of this gadget is expected to precipitate a paradigm shift within the feasibility and sustainability of electrical motors in forthcoming years.

2. Exiting system

WEVC systems get rid of the want for touch with the aid of the usage of magnetic fields to transfer energy from primary ground coils to secondary car coils. Current structures use round or double-D coils due to resonant inductive strength switch era, however they war with dynamic charging and misaligned coil problems, main to long charging instances. Recent designs try to improve alignment tolerance, however they may be big, high-priced, and impractical for extensive use. Several troubles exist with static wireless charging for electric motors via inductive electricity transfer inclusive of a large air gap distance among the transmitter and receiver coils that will increase losses. Precise alignment is required for powerful electricity transmission, making the gadget liable to orientation disparities. Static charging limits automobile mobility by requiring prolonged charging intervals, and wireless charging structures can generate Electromagnetic Interference potentially posing safety and health risks, complicating the venture of scaling up wi-fi EV charging.

3. Proposed Solution

Dynamic Wireless Power Transfer (DWPT) is characterized by the technique of charging electric motors in transit through the utilisation of Wireless Power Transfer generation. This technique well-knownshows certain advantages vis-a-vis static wireless charging and traditional battery systems employed in Electric Vehicles (EVs). Notably, EVs prepared with DWPT era do no longer necessitate massive battery capacities because of their continuous charge replenishment abilities, analogous to traditional fuel-powered motors. This machine predominantly relies on inductive power transfer, in which coils located under road surfaces emit a magnetic subject, facilitating electrical switch to receiving coils situated on automobiles. Recent adaptations of the dynamic wireless EV charging idea, integrating rectangular coils and solar power, goal to enhance on-street charging safety and performance with the aid of purportedly growing the strength output efficacy thru the deployment of continuous coil configurations.

A dynamic charging machine can switch power through elevated magnetic linkage and uniform fields, decreasing magnetic area leakage, electromagnetic interference and enhancing protection for pedestrians and avenue customers. The device capabilities solar energy as a renewable electricity source, providing strength for charging wi-fi charging stations via panels included into roads or road materials. This setup creates a synergistic effect, combining regular vehicle charging whilst in motion with renewable power sources to form a purifier transportation system. Unlike traditional double-drum electric powered machines, the device is based totally on segmented coil tracks which simplest prompt whilst an EV is nearby, retaining electricity and minimizing emissions.

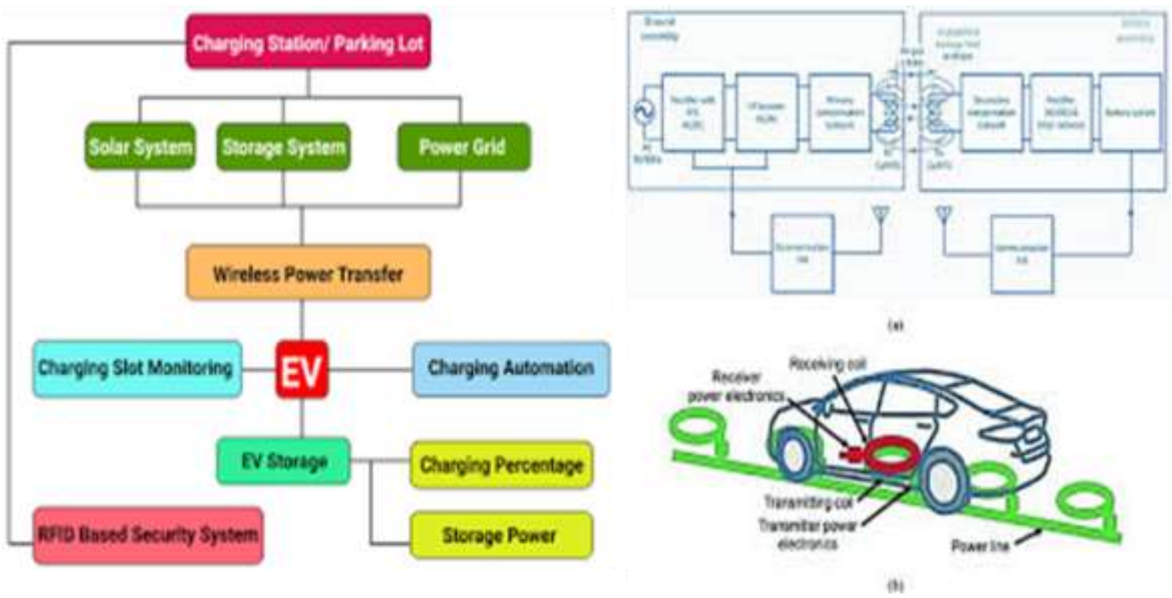

Figure .1 EV Charging System

4. Methodology

The steps in reading the dynamic wi-fi EV charging machine involve gathering and analyzing statistics, in addition to the use of MATLAB Simulink to design the product thru simulation, for you to assess the device's viability, pace, and performance in its operational mode.

a. Data Collection and Analysis

Data series efforts were undertaken to accumulate vital data for discerning variables influencing DWEC. Relevant info concerning vehicular visitors density, street surface traits, electromagnetic fields, and electric vehicle strength consumption prices were compiled. Additionally, sun radiation intensity and grid energy deliver data have been obtained to facilitate an exam of the integration potential among renewable energy sources and charging stations.

This information become sourced from pre-present studies, experiments, and transportation datasets to offer a strong basis for subsequent simulation models.

b. Data Analysis

The analyzed facts showed styles for refining wireless charging generation. Key elements inclusive of coil alignment, airgap versions, street kinds, and automobile speed have been examined to optimize power switch performance. Statistical evaluation and computational gear helped expand parameters for the coils, strength electronics, and manipulate systems. These outcomes knowledgeable the selection of choicest coil sizes, shapes, and configurations to reduce electricity waste and boost efficiency.

c. Modeling

A Matlab Simulink version became created to simulate a dynamic wireless electric powered automobile charging machine, offering sensible and dynamic WPT conditions. The system modeled square-fashioned number one coils beneath the street and secondary coils on EVs. A block diagram describes the proposed device's operation and additives, inclusive of how they have interaction to facilitate dynamic wi-fi charging.

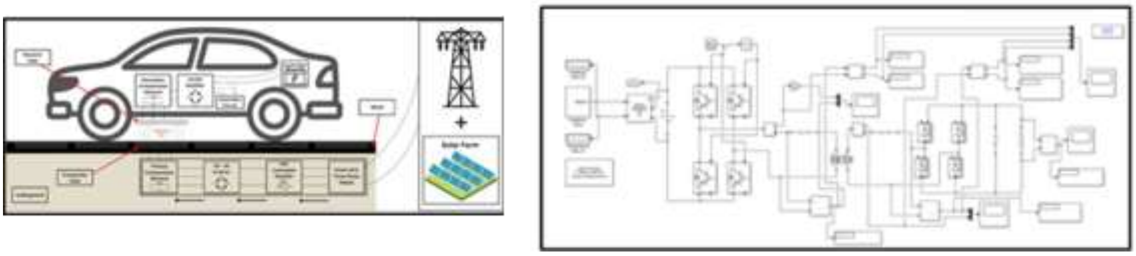

Figure .2. Simulation Model

A scaled-down prototype became designed and constructed to demonstrate the capacity of dynamic wireless electricity switch by means of mimicking the main machine's functionality. The prototype's wireless charging system became tested below diverse conditions to assess its overall performance. It effectively showcased the feasibility of charging a car wirelessly from the road the usage of coils embedded underneath the road floor. The prototype applied MOSFETs to convert DC strength to a magnetic field for inductive charging and relied on a microcontroller and a battery management device to modify energy output.

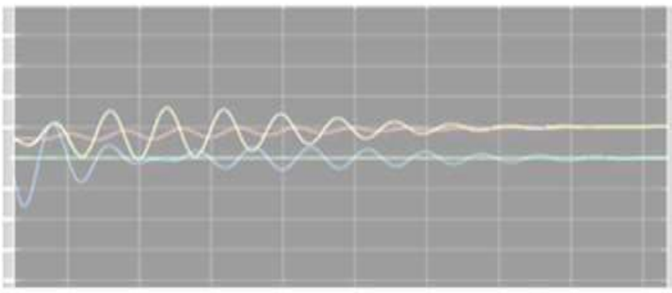

Figure .3. Simulation Results

5. Proposed Model

A jogging automobile version become devised and applied to affirm the feasibility of the proposed wi-fi EV charging machine. The incorporation of solar panels served to augment the prototype's power supply, thereby sub statist incorporating renewable energy as a supplementary strength supply. Effective integration and interdependence among the prototype's additives facilitated the achievement of the predetermined goals, thereby substantiating the viability of the DW-EVC concept.

S.No	Components	Description
1	Square Coils	Essential for generating the magnetic field required for wireless power transfer to the EV.
2	MOSFET	Critical for controlling the power flow, and involved in inverter circuit ensuring efficient wireless power transfer
3	ATMega328p	Key controller that manages the entire charging process and system operations

S.No	Components	Description
4	Battery Management System	Vital for monitoring and protecting the rechargeable battery during charging.
5	Rechargeable Battery	Stores the wirelessly transferred energy for use in powering the electric vehicle
6	Electrolytic Capacitor	Provides energy storage and voltage stabilization, smoothing out power delivery in the circuit
7	Crystal Oscillator	Ensures accurate timing and operation of the microcontroller for system coordination.
8	Ceramic Capacitors	Important for filtering and maintaining signal integrity in the circuit.
9	Solar Panel	Harvests solar energy and couples it with the input power supply in a renewable way to provide the wireless charging system with a sustainable renewable source, making it less dependent on the grid.
10	DC Gear Motor 12V	Used to move the vehicle on the road and above coils.

Table I. Components used

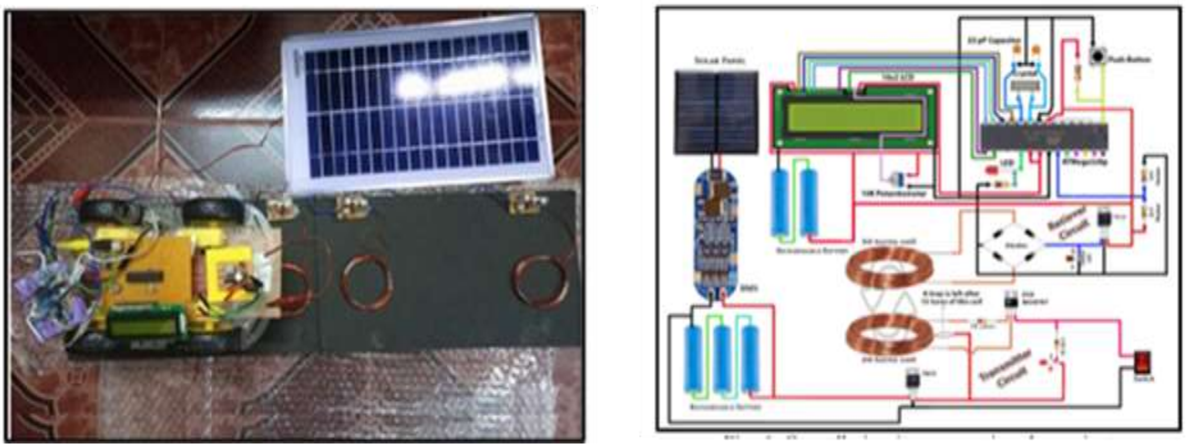

Figure.4. Hardware Kit

6. Conclusion

The wireless charging system premised on square coils, leveraging sun electricity, the corporation's endeavors to boost electric car Technology. This revolutionary layout addresses two key barriers inherent in traditional systems presenting round coils: electromagnetic crosstalk, thereby mitigating energy trade inefficiencies. In so doing, the incorporation of rectangular coils enables the enhancement of energy switch coefficients at the same time as concurrently diminishing electromagnetic interference, thereby fostering substantially more secure and extra reliable automotive operation inside its surroundings. Moreover, the integration of solar electricity as an detail of the charging infrastructure proves efficacious in providing a sustainable transportation paradigm. This technique effectively diminishes reliance on direct grid strength, thereby rendering it a extra environmentally benign method of charging. The utilization of solar panels, whether or not seamlessly integrated into roadsides or hired as standalone installations, affords an ongoing source of renewable electricity that contributes to a reduction in carbon dioxide emissions, in the end fostering a extra environmentally pleasant transportation landscape.

References

[1] S. Zhang and J. J. Q. Yu, "Electric Vehicle Dynamic Wireless Charging System: Optimal Placement and Vehicle-to-Grid Scheduling," in IEEE Internet of Things Journal, vol. 9, no. 8, pp. 6047-6057, 15 April 15, 2022, doi: 10.1109/JIOT.2021.3109956

[2] A. Triviño, J. Sánchez and A. Delgado, "Efficient Methodology of the Coil Design for a Dynamic Wireless Charger," in IEEE Access, vol. 10, pp. 83368-83378, 2022, doi: 10.1109/ACCESS.2022.3196023.

[3] Design and Performance Analysis of Misalignment Tolerant Charging Coils for Wireless Electric Vehicle Charging Systems by Eiman ElGhanam, Mohamed Hassan, Ahmed Osman and Hanin Kabalan [4] M. Adil, J. Ali, Q. T. H. Ta, M. Attique and T. -S. Chung, "A Reliable Sensor Network Infrastructure for Electric Vehicles to Enable Dynamic Wireless Charging Based on Machine Learning Technique," in IEEE Access, vol. 8, pp. 10.1109/ACCESS.2020.3031182. 187933-187947, 2020, doi:

[5] Kosmanos et al., "Route optimization of electric vehicles based on dynamic wireless charging", IEEE Access, vol. 6, pp. 42551-42565, 2018. [6] S. Li and C. C. Mi, "Wireless power transfer for electric vehicle applications", IEEE J. Emerg. Sel. Topics Power Electron., vol. 3, no. 1, pp. 4-17, Mar. 2015.

[7] J. Deng, W. Li, T. D. Nguyen, S. Li and C. C. Mi, "Compact and efficient bipolar coupler for wireless power chargers: Design and analysis", IEEE Trans. Power Electron., vol. 30, no. 11, pp. 6130-6140, Nov. 2015.

[8] M. R. R. Razu et al., "Wireless Charging of Electric Vehicle While Driving," in IEEE Access, vol. 9, pp. 157973-157983, 2021, doi: 10.1109/ACCESS.2021.3130099.

[9] State-of-the-Art Research on Wireless Charging of Electric Vehicles Using Solar Energy by Seyed Ali Kashani, Alireza Soleimani, Ali Khosravi and Mojtaba Mirsalim

[10] Md M. RANA, WEI XIANG, Internet of Things Infrastructure for Wireless Power Transfer Systems, IEEE Access, volume 6, pp.1929519303, 24 Jan 2018.IEEE Authorized licensed use limited to: NATIONAL INSTITUTE OF TECHNOLOGY CALICUT. Downloaded on July 01,2025 at 12:24:01 UTC from IEEE Xplore. Restrictions apply.