



Resonant Inductive Wireless Power Transfer for Dynamic EV Charging

Presented by_

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- 1. Project Area** : EV/Embedded Systems/Power Electronics
- 2. Project Title** : Resonant Inductive Wireless Power Transfer for Dynamic EV Charging
- 3. Place of Work** : In-house
- 4. Supervisor Name** : Mr. N. Suresh
- 5. Project Group** : Batch 5

Motivation & Application

Motivation

- Increased Convenience and Enhanced Efficiency
- Efficient use of battery
- Sustainability
- Energy Management

Application

Heavy-Duty & Commercial EVs

- Charge while driving
- Smaller batteries
- Zero downtime
- Higher fleet uptime
- No grid overload

Literature Survey

PAPER TITLE & AUTHOR	WORK	OUTCOME
Simulation-Based evaluation of dynamic wireless charging systems for electric vehicles	Efficiency, limitations, and future directions	Understanding of efficiency limiting factors, including misalignment, gap variation, and load fluctuations.
Magnetic Resonance Coupling Modelling for Electric Vehicles Wireless Charging	Discusses resonant inductive coupling in motion	Validates our use of 21kHz magnetic resonance
Smart Wireless Resonant Charging of Electric Vehicles (EV)	Wireless power transfer systems, including coil configuration and materials	Configuration and materials used in real world scenarios
ESP32 & IoT Billing for EVs – ResearchGate	Implementation of ESP32 for vehicle data sync	Supports our use of ESP32 for billing integration
Magnetic Resonance Coupling Modelling for Electric Vehicles Wireless Charging	The feasibility of wireless power transfer for Electric Vehicles by electromagnetic resonance coupling is modelled in this paper.	Wireless energy transfer system reaches the maximum (96%) at the resonant frequency

Problems Identified and Solutions Suggested

Problem:

Grid Bottleneck: Static charging nodes can't meet the high current demand of cargo fleets, leading to local grid congestion and queuing delays.

Oversized Batteries: Lack of in-transit charging forces use of large Li-ion packs, increasing vehicle mass, cost, and peak grid load.

Downtime: Plug-in charging causes 1–2 hrs idle time, reducing fleet utilization.

Solution:

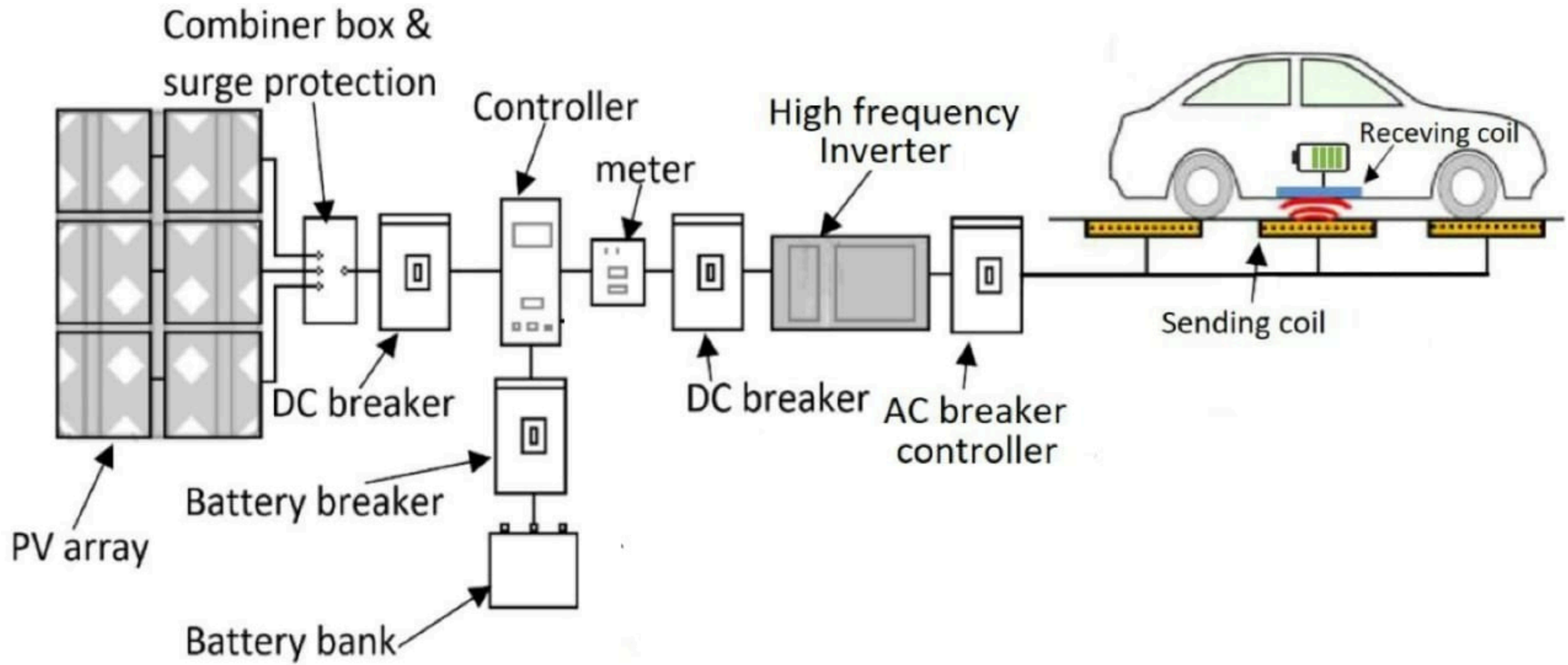
Dynamic Wireless Power Transfer (DWPT): Enables ~50% smaller batteries, cutting vehicle cost by ~40%.

High Efficiency: Resonant inductive coupling achieves 80–90% transfer efficiency.

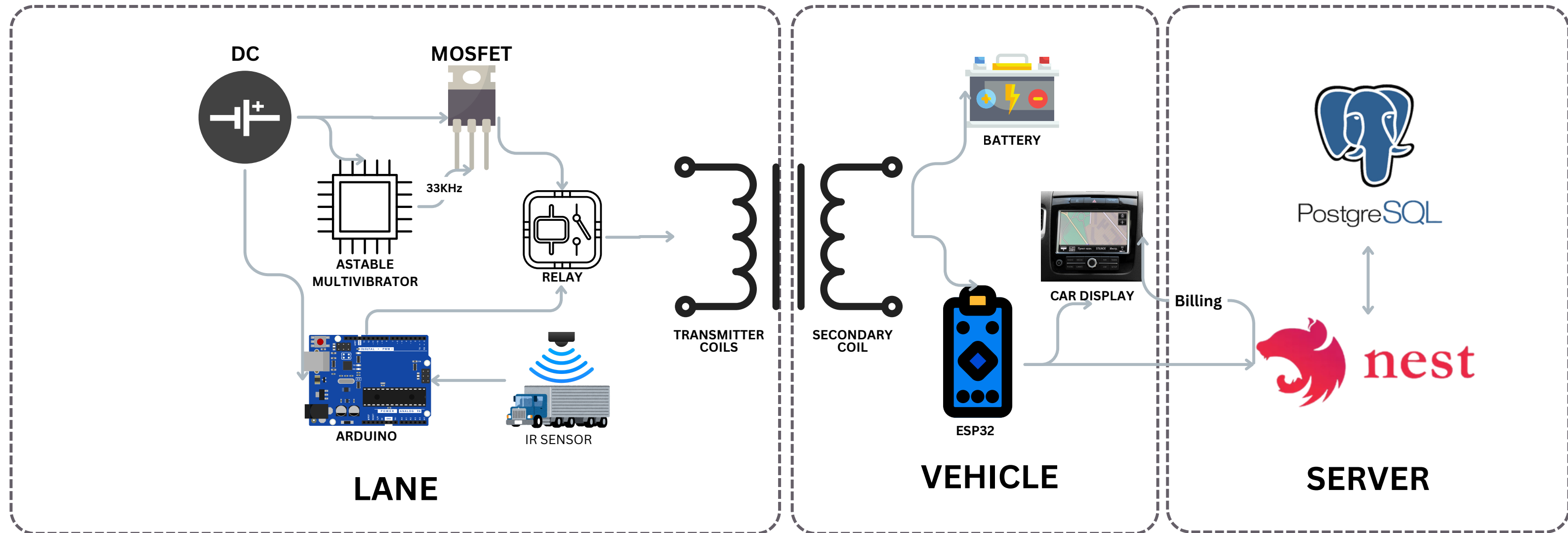
Sustainability: Reduces lithium demand, CO₂ emissions, and e-waste.

Continuous Operation: In-motion charging provides limitless range and maximum logistics throughput.

Block Diagram

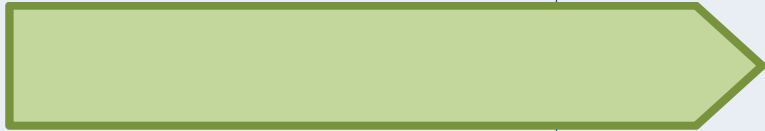
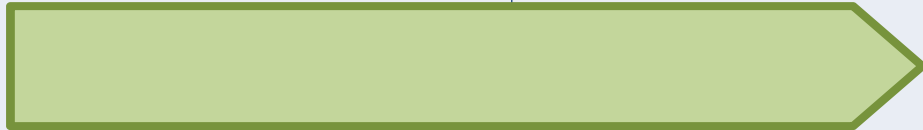





Objectives of the Project



- Develop a DWPT system delivering 80–90% efficient in-motion charging, reducing EV battery size by up to 50%.
- To improve the overall efficiency of EV

Plan of Action

	DECEMBER 2025	JANUARY 2025	FEBRUARY 2026	MARCH 2026
TASK				
Literature Survey				
Design				
Simulation				
Hardware Implementation				
Report Preparation				

SDG

SDG Goals	Project Contribution
Goal 11 – Sustainable Cities and Communities	Reduces fossil fuel dependency, lowers air pollutionBy enabling continuous electric operation of heavy-duty vehicles, the system cuts diesel usage, reduces urban freight emissions, and supports cleaner, quieter logistics—directly improving air quality and sustainability in cities (SDG 11).

Feasibility and Cost Analysis

How feasible is wireless transmission?

- Proven pilots: Sweden (Gotland, 1.65 km) showed trucks charged while driving with >85% efficiency; Israel (Tel Aviv) and South Korea (Gumi buses) also operate real segments.
- Economic studies: Research (KAIST, eRoadArlanda, Electreon pilots) show payback periods of ~5–7 years are possible if deployed at scale, though upfront costs (₹15–30 Cr/km vs ₹10–20 Cr/km for normal roads) are high.
- Challenges: High infrastructure cost, standardization, and scaling to highways.
- Opportunity: Reduces range anxiety, enables smaller batteries, and increases EV adoption.

Cost analysis

Metro Rail Construction Costs

- Elevated Metro: ₹150–300 crore/km
- Underground Metro: ₹250–500 crore/km
- Example: Bengaluru Metro Phase 3A: ₹776 crore/km Deccan Herald

Dynamic MR Charging Infrastructure Costs

- Global Estimate: ~₹16.6 crore/km (based on \$2 million/lane-km) Railway Technology.
- ROI Consideration: Dynamic charging can reduce EV battery size and charging time, potentially lowering operational costs.

References

1. S. Malini, R. R. Hariharan, R. Naveen Kumar, R. Ragul, and S. Vijay Prabhu, “Smart Wireless Resonant Charging of Electric Vehicles (EV),” 2024 10th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2024, pp. 919–923, doi: 10.1109/ICACCS60874.2024.10717057
2. Wireless Power Transfer for EVs – IJAREEIE K. Rajkumar, R. Kumar, and S. Praveen, “Wireless Power Transfer for Electric Vehicles Using Resonant Inductive Coupling,” International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol. 6, no. 10, pp. 7768–7773, 2017.
3. E. Ayisire, A. El-Shahat, and A. Sharaf,
“Magnetic Resonance Coupling Modelling for Electric Vehicles Wireless Charging,”
in Proc. IEEE Conference on Power Electronics, Georgia Southern University, USA, 2018,
4. Bukya, R., & Mangu, B. (2022). Wireless EV Battery Charging system using circular-square coupled coils with interoperability and misalignments. International Journal of Engineering & Computer Science & Electronics, 14, 6080–6096.
5. A. El-Shahat and E. Ayisire,
“An Adaptive Resonant Inductive Wireless Charging System for Electric Vehicles,” AIMS Energy, vol. 13, no. 2, pp. 345–364, Feb. 2025, doi: 10.3934/energy.2025023.