Sri Venkateswara College of Engineering

Dynamic Charging of EV using Magnetic Resonance Charging

Presented by

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1. **Project Area** : EV/Embedded Systems/Power Electronics
2. **Project Title** : Dynamic Charging of EV using Magnetic Resonance Charging
3. **Place of Work** : In-house
4. **Supervisor Name** : Dr. S Arulmozhi
5. **Project Group** : Batch 5

Motivation

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

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 efficiencylimiting 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:

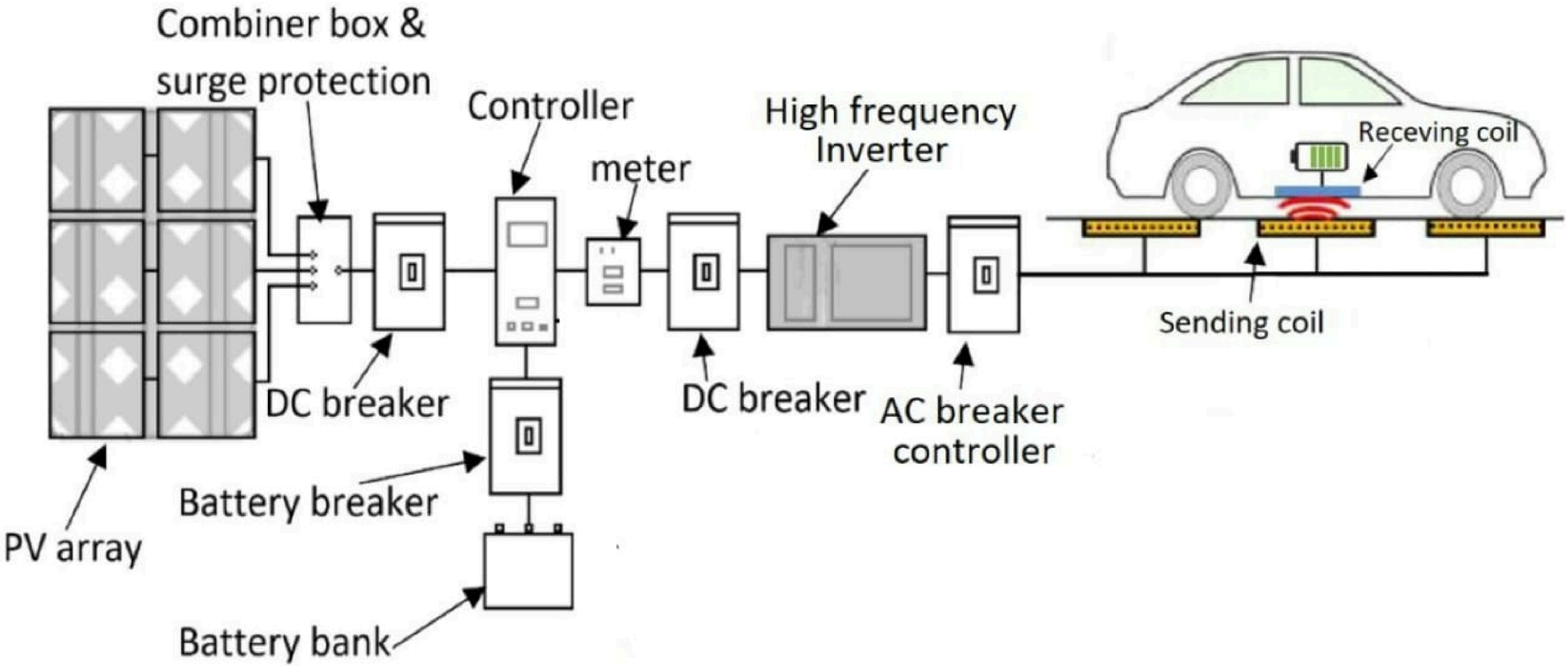
Dynamic Wireless Power Transfer (DWPT): Enables ~50% smaller batteries, cutting vehicle cost by ~40%.

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

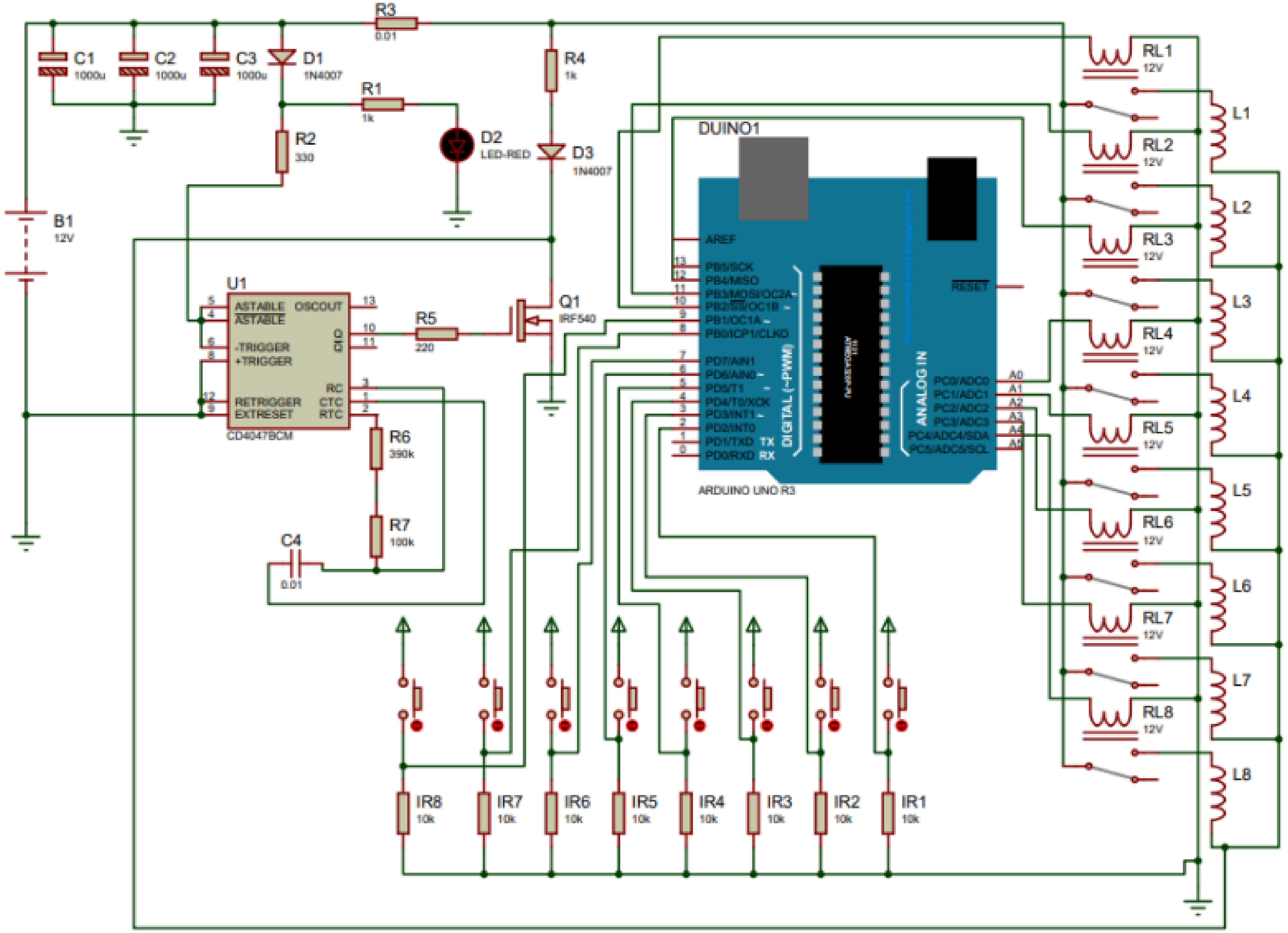
Sustainability: Reduces lithium demand, CO_2 emissions, and e-waste.

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

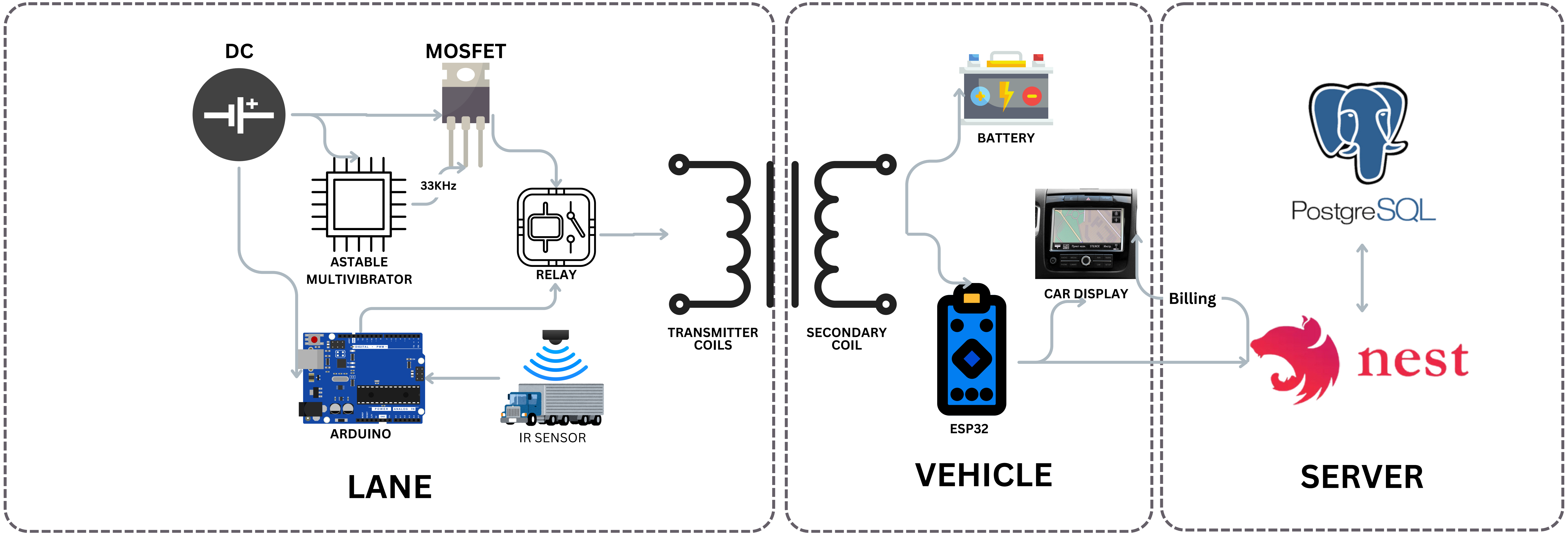
Block Diagram



Circuit Design

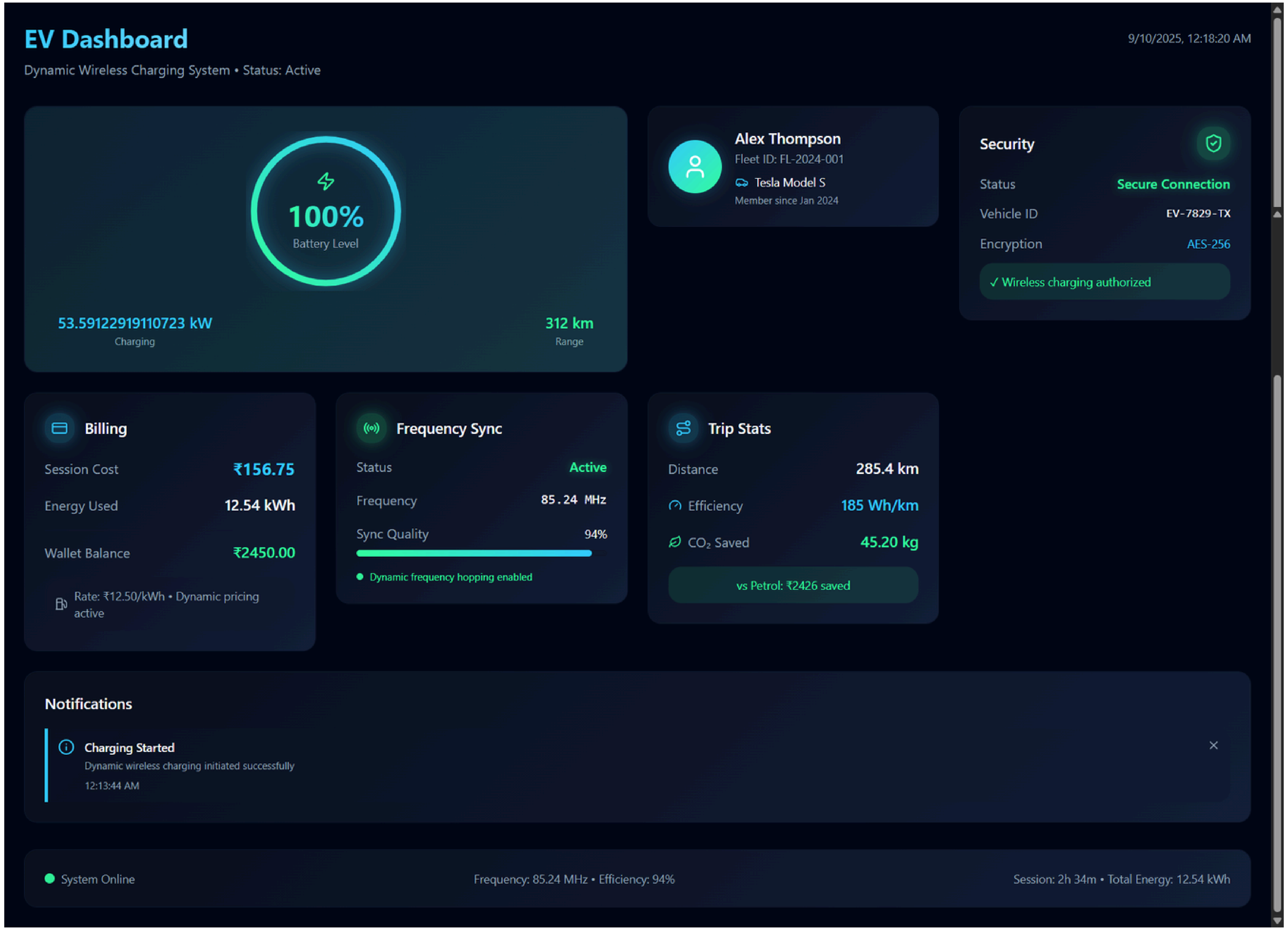


Objectives of the Project



- 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

User Dashboard



Devices to Use:

Voltage Measurement:

Hall-Effect Voltage Sensors (isolation, works at high switching frequencies).

Current Measurement:

Rogowski Coil Sensors – excellent for high-frequency currents in coils.

Power/Energy Metering ICs (all-in-one chips):

ADE7753 / ADE9153A (Analog Devices) → industry standard for smart energy metering.

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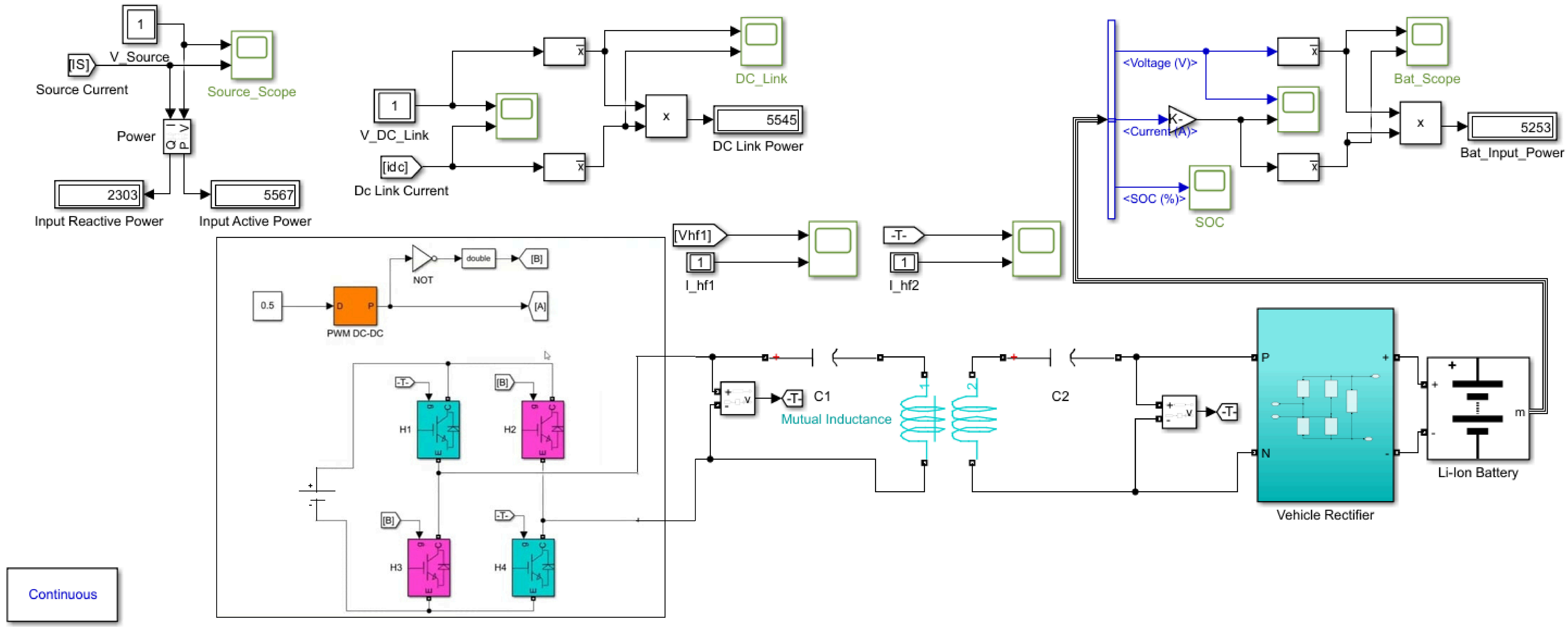
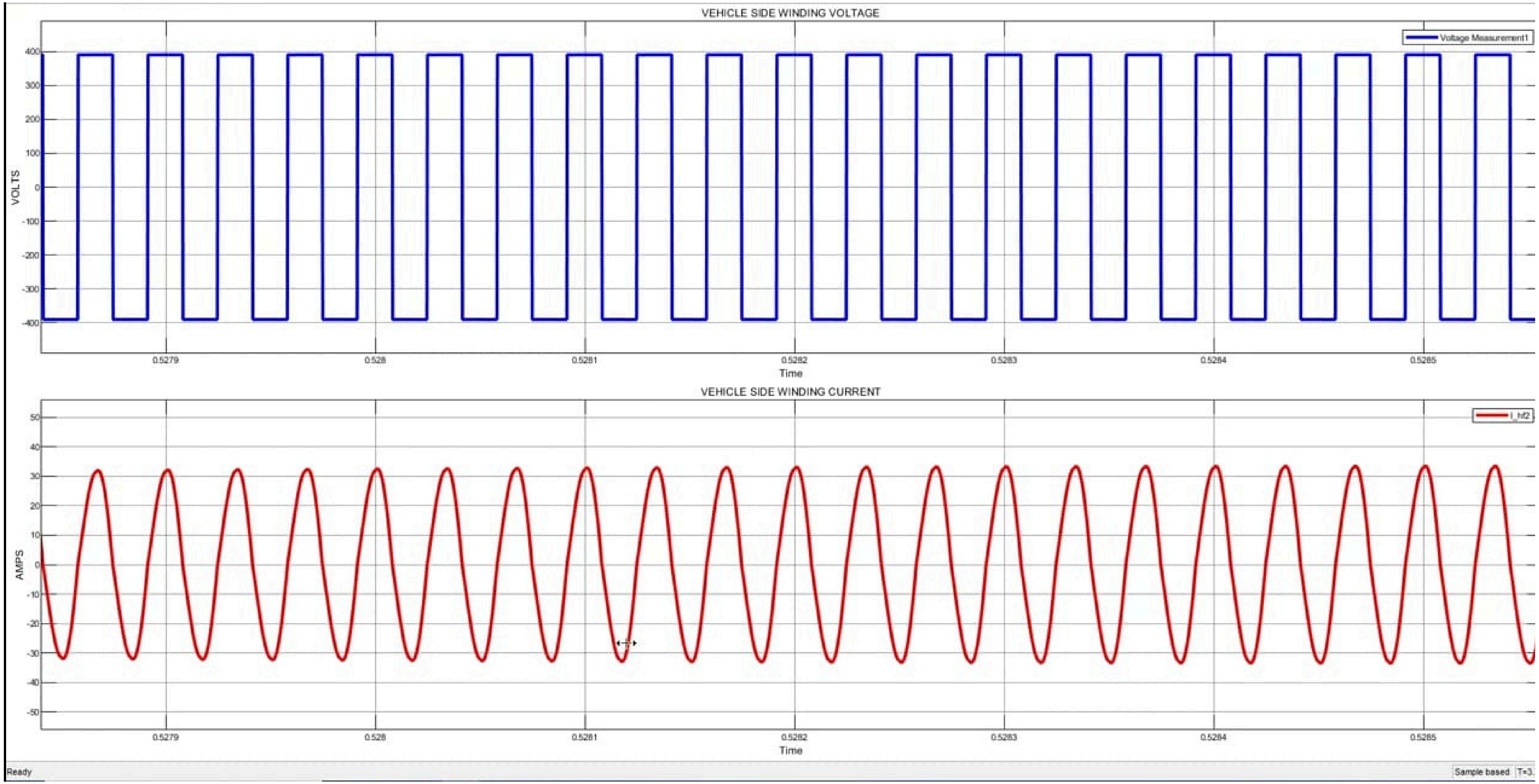
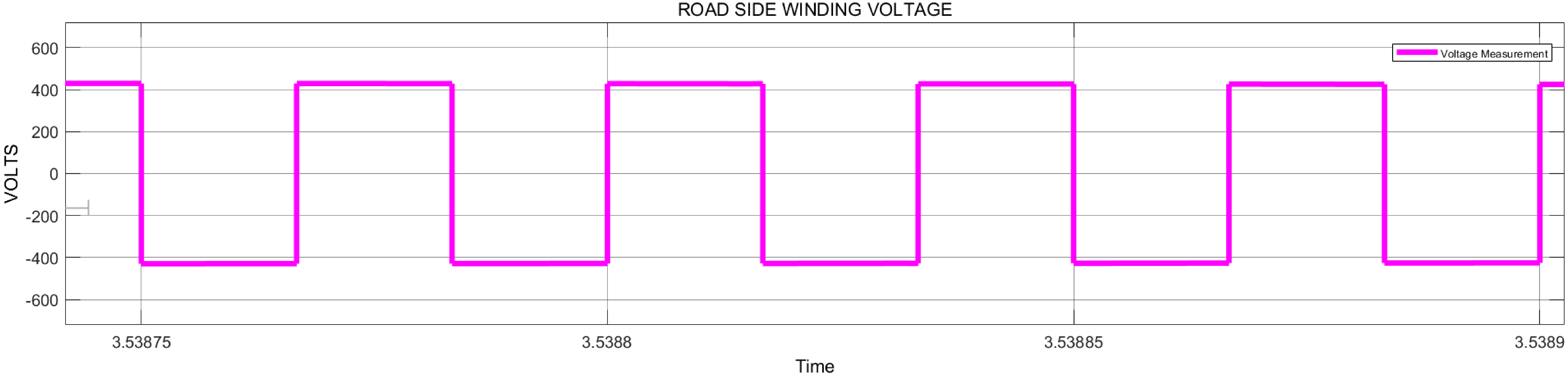
Dynamic wireless charging - simulation

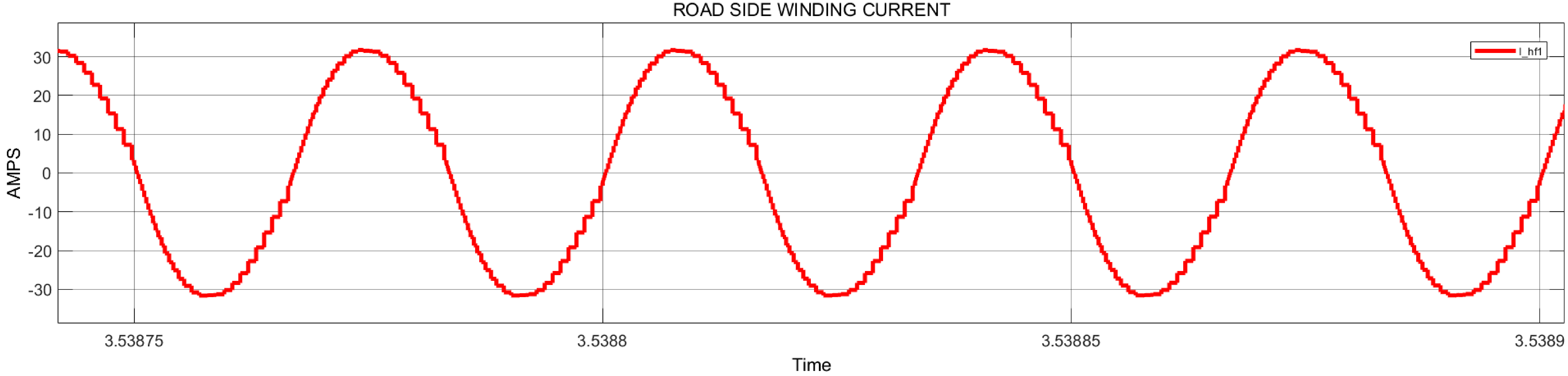


Source side Voltage and Current

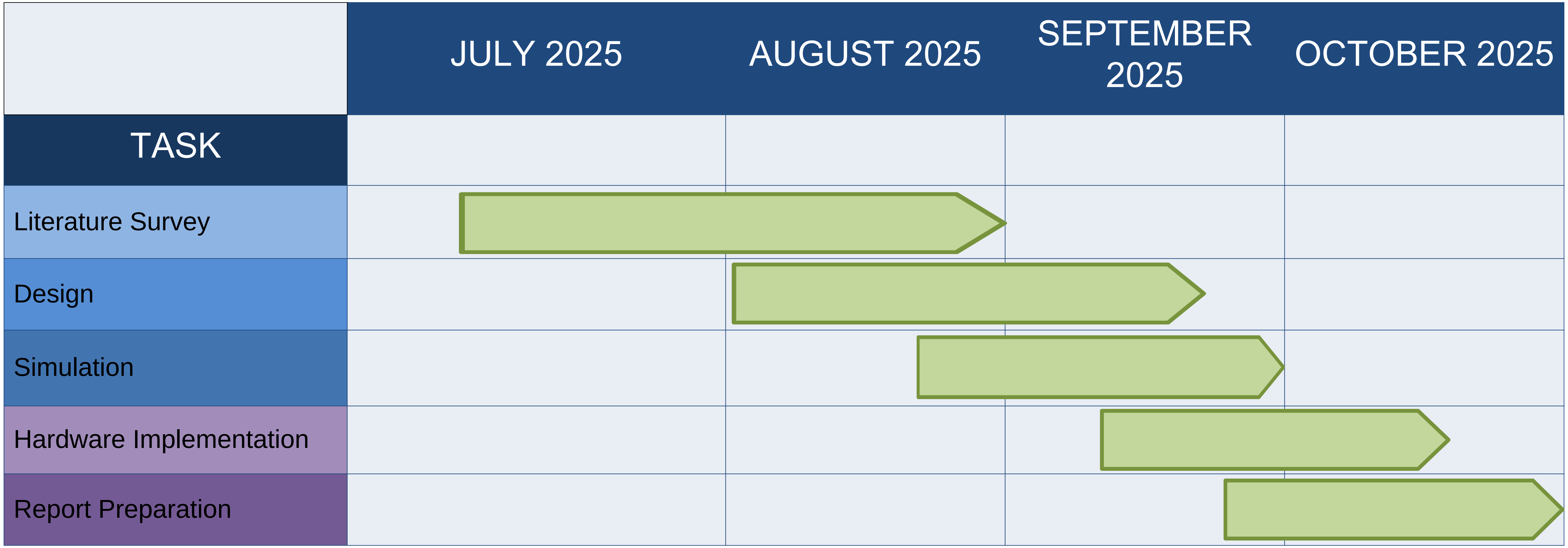


Transmission side Voltage and Current





Plan of Action



SDG

SDG Goals	Project Contribution
Goal 9 – Industry, Innovation and Infrastructure	Modernizes transport infrastructure using embedded charging
Goal 11 – Sustainable Cities and Communities	Reduces fossil fuel dependency, lowers air pollution

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

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