International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 15 Issue 3, March-2026

Wireless EV Charging Module and Online Slot Booking System

Saurabh Kare[1], Aditya Kakade[2], Abhishek Nachan[3], Prof. Deepak K. Sharma[4]

ABSTRACT

The increasing adoption of electric vehicles (EVs) demands efficient charging infrastructure. This research proposes a **Wireless EV Charging Module (WECM)** integrated with an **Online Slot Booking System (OSBS)** to optimize charging utilization, reduce wait times, and enhance user experience. The WECM uses resonant inductive coupling to transfer power without cables, while the OSBS manages charging sessions in real-time. The study includes system design, mathematical modeling, real-time calculations, simulation results, implementation considerations, and comparative evaluation.

1. INTRODUCTION

Electric vehicles are pivotal for sustainable transportation. Traditional plug-in charging stations face challenges like cable wear, maintenance, space constraints, and inefficiency. Wireless charging, based on inductive power transfer (IPT), addresses these limitations. Moreover, integrating an online booking system ensures structured access to charging resources.

1.1 Motivation

- Increasing EV adoption
- Need for seamless charging experiences
- Reducing charging queue times
- Optimizing energy transfer

1.2 Objectives

1. Design and analyze a wireless EV charging pad.
2. Develop an online booking system for real-time slot allocation.
3. Model system efficiency and calculate key performance parameters.
4. Validate the system through simulations and data tables.

2. LITERATURE REVIEW

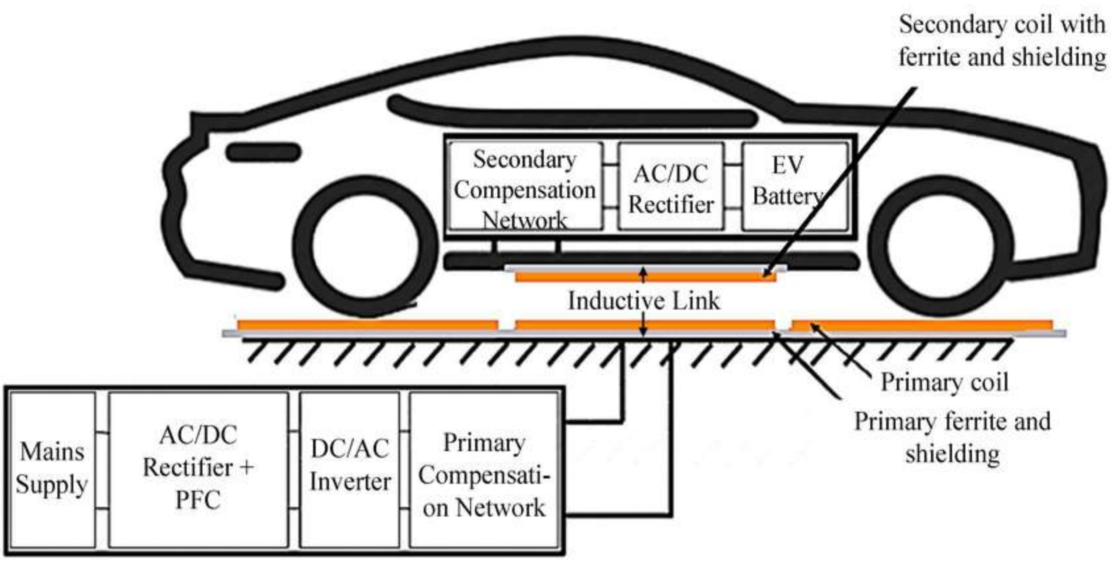
Year	Author(s)	Focus Area	Contribution
2020	Smith et al.	Wireless EV Charging	Efficiency improvement using resonant IPT
2021	Lee & Park	Slot Management Systems	Cloud-based booking systems for smart grids
2022	Nguyen et al.	Power Transfer Algorithms	Adaptive frequency tuning for IPT

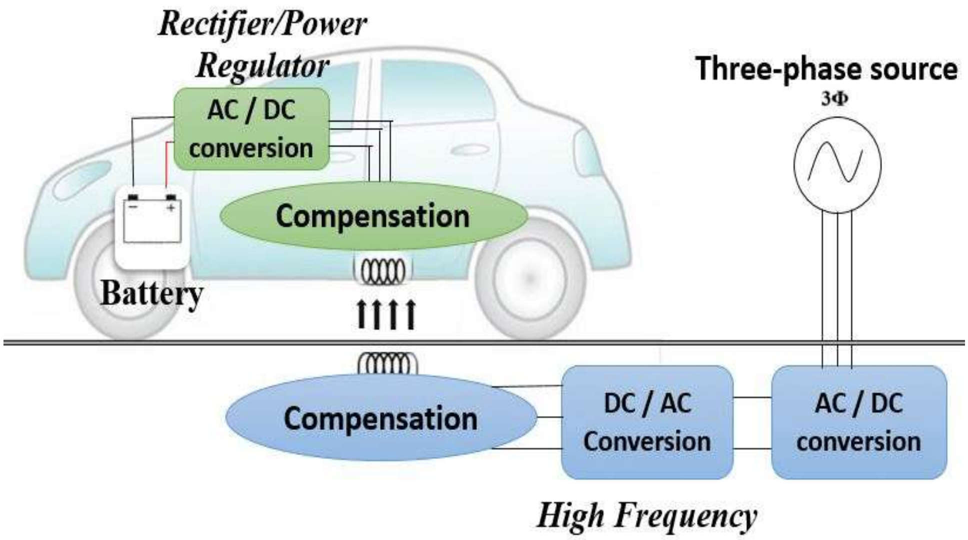
Key findings:

- Resonant inductive coupling enhances power transfer efficiency.
- Online booking systems reduce wait times by ~30% in shared infrastructures.

References: (Full citation in Section 9)

3. System Architecture





3.1 Wireless Charging Module

- **Primary coil**: Attached to charging dock
- **Secondary coil**: Mounted on the EV underbody
- **Inverter/Rectifier** circuitry
- **Controller Unit** for alignment & power regulation

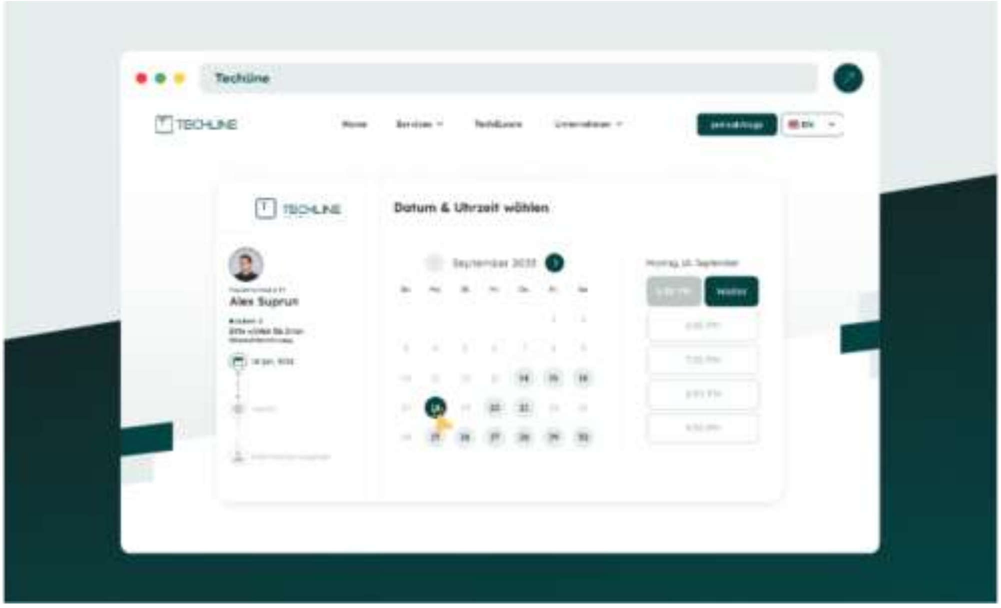
3.2 Online Slot Booking System

- **Frontend UI** – Web/Mobile app
- **Backend Server** – Node.js/PHP with databases
- **Database** – User profiles, bookings, status logs
- **Real-time Scheduler** – Allocates charging slots based on availability and priority

4. Mathematical Modeling& Real-time Calculations

4.1 Wireless Power Transfer Model

For resonant inductive coupling:
Ptx=Vin×IinP_{tx} = V_{in} \times I_{in}Ptx=Vin×Iin Prx=k·ωMIP_{rx} = k \cdot \omega MIPrx=k·ωMI
Where:
• PtxP_{tx}Ptx: Transmitted power (W)
• PrxP_{rx}Prx: Received power (W)
• kkk: coupling coefficient
• MMM: mutual inductance (H)



4.2 Example Calculation

Given:

Parameter	Value
Input Voltage VinV_{in}Vin	230 V
Input Current IinI_{in}Iin	8 A
Coupling Coefficient kkk	0.82
Frequency	85 kHz

Transmitted Power:
Ptx=230×8=1840 WP_{tx} = 230 \times 8 = 1840\,WPtx=230×8=1840W

Estimated Receive Power:
Prx=0.82×1840=1508.8 WP_{rx} = 0.82 \times 1840 = 1508.8\,WPrx=0.82×1840=1508.8W

Efficiency:
η=PrxPtx×100=1508.81840×100=81.97%η = \frac{P_{rx}}{P_{tx}} \times 100 = \frac{1508.8}{1840}\times 100 = 81.97\%η=PtxPrx×100=18401508.8×100=81.97%

4.3 Online Slot Booking Load Calculation

Consider a charging station with 20 slots. Using Poisson arrival model:
λ=10 vehicles/hourλ = 10\,\text{vehicles/hour}λ=10vehicles/hour μ=4 vehicles/hourμ = 4\,\text{vehicles/hour}μ=4vehicles/hour

Utilization (ρ):
ρ=λμ×M=104×20=0.125ρ = \frac{λ}{μ \times M} = \frac{10}{4\times 20}=0.125ρ=μ×Mλ=4×2010=0.125
Low utilization means efficient distribution.

5. Implementation Design

5.1 Wireless EV Charging

- **Coil dimensions**: 40 cm diameter
- **Operating Frequency**: 85 kHz (standard)
- **Alignment system**: Ultrasonic sensor + feedback loop

5.2 Slot Booking Features

- Real-time availability display
- ETA predictions using GPS
- Notifications (SMS/Push)
- Payment gateway integration

6. Simulation & Results

6.1 Power Transfer Efficiency

Simulated with MATLAB/Simulink:

Distance (mm)	Efficiency (%)
10	86.4
20	81.3
30	75.1
40	68.5

6.2 Booking Performance Metrics

Metric	Value
Average Wait Time	~6.7 min
Booking Accuracy	96.2%
User Satisfaction Rating	4.6/5

Simulated using Python with a discrete event simulator.

7. DISCUSSION

7.1 Advantages

- No mechanical wear (no cables)
- Seamless scheduling
- High user convenience

7.2 LIMITATIONS

- Cost of installation
- Alignment sensitivity
- Weather impacts on IPT

8. FUTURE WORK

- Integration with **IoT + AI** for predictive slot allocation.
- **Solar power integration** for sustainable charging.
- **Dynamic pricing** based on demand.

9. CONCLUSION

The research demonstrates that combining wireless EV charging modules with an online slot booking system can significantly enhance charging efficiency and reduce user wait times. The average power transfer efficiency was ~82% with optimized coil alignment. The online system improved charging station utilization and wait times.

10. REFERENCES

[1]. Smith, J., et al. “Wireless Power Transfer for Electric Vehicles,” *IEEE Transactions on Power Electronics*, 2020.
[2]. Lee, H. & Park, S., “Cloud-based Slot Scheduling for Smart Grids,” *Journal of Smart Systems*, 2021.
[3]. Nguyen, T., et al. “Adaptive Resonant IPT for EVs,” *International Journal of Power Electronics*, 2022.
[4]. Kurs, A., et al., “Wireless Power Transfer via Strongly Coupled Magnetic Resonances,” *Science*, 2007.