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Design and Implement Smart and Power Efficient Wireless Charger for Electric Vehicles Using WPT.

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Contents

Problem Statement

Key Issues:

1. Safety hazards from sparking during plugging/ unplugging.
2. Inaccessibility for disabled people for traditional plug chargers.
3. Power loss due to coil misalignment and gap variations.
4. Driver dependency for precise parking.

Fig.1 Existing wireless charging car

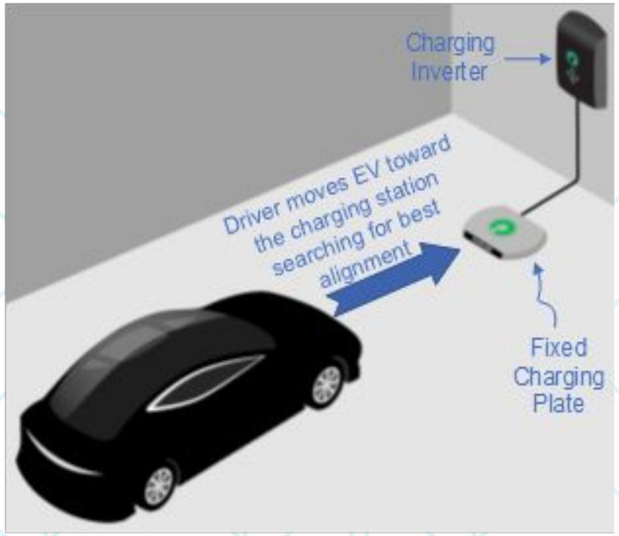

Fig.2 Conventional Wireless EV Charging

Background

Already-Existing Charging Issues:

- Wired: Sparking, and Inaccessibility.
- Wireless: Misalignment, and driver dependency.

Technical Limitations:

- Efficiency drops with distance (140–210 mm).
- Coil misalignment causes up to 30% power loss.

Industry Trends:

- Tesla, BMW, and Nissan

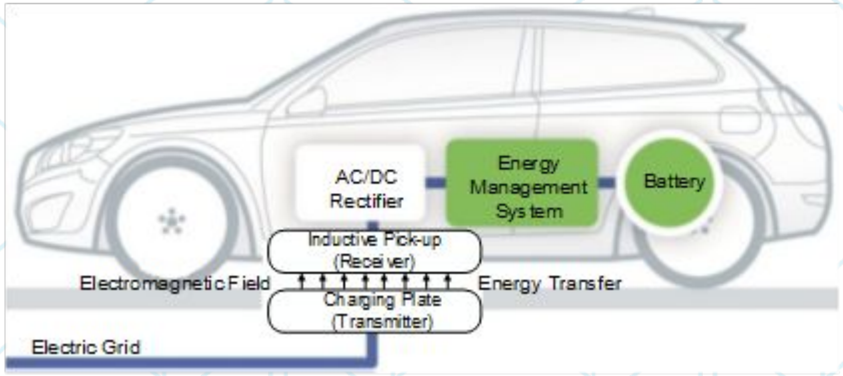

Fig.3 Conventional Wireless EV Charging

Objectives and Criteria

Aim: Developing a smart, power-efficient wireless charging system for EVs.

The Project is divided into two main streams:

- **Wireless Charger Design:**
  - Compensation topology optimization.
  - Optimize coil geometry, materials, and gaps.
  - Experiment with air gaps (5–30 mm) and lateral misalignment (0–20 cm)
  - Integrate ferrite cores or metamaterials.

Objectives and Criteria

- **Autonomous Mechanism Design:**
  - Design a small 4-wheeled robotic car.
  - Enable the car to autonomously.
  - Implement obstacle avoidance.

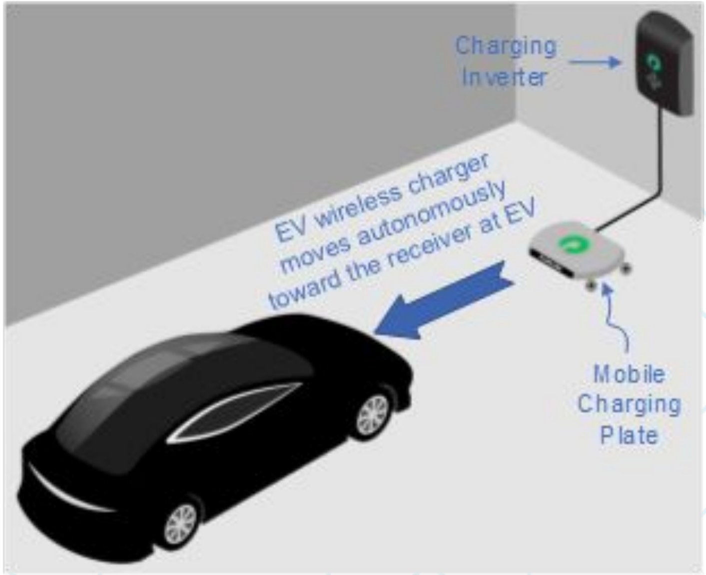

Fig.4 Proposed Autonomous Mechanism

Roadmap

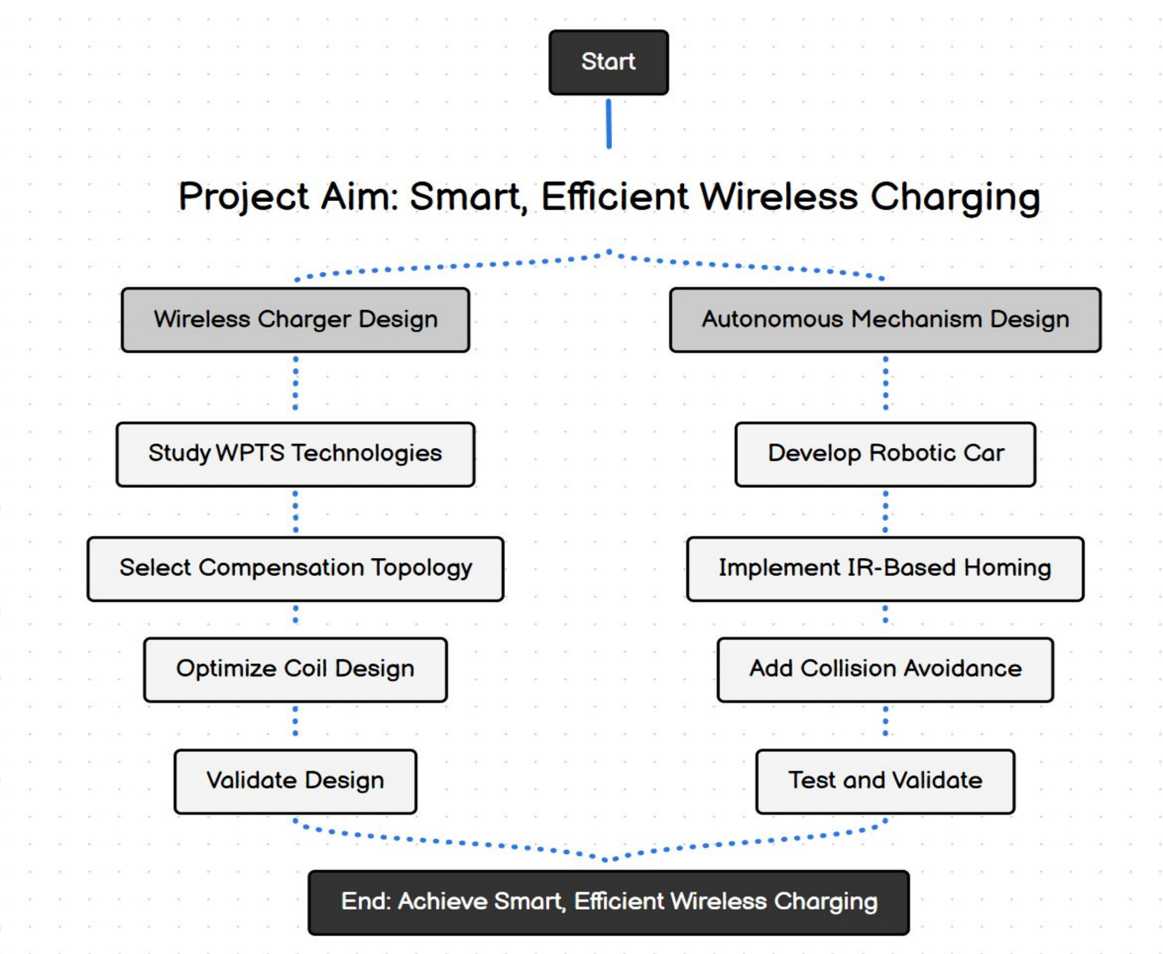

Fig.12 Roadmap

Resources Required

- **Hardware:**
  - Coils (Litz wire, ferrite cores), power electronics (inverters, rectifiers).
  - Robotic car (DC motors, Arduino Mega, IR sensors).
- **Software:**
  - Simulink, ANSYS Maxwell, Visual Studio Code.
- **Lab Equipment:**
  - Oscilloscopes, power analyzers, multimeters.

Fig.13 Litz wire coils

Conclusion

3. Wireless Charger

3.1 Selected SS Topology

3.1.1 High Efficiency > 95%

3.1.2 Misalignment tolerance.

3.1.3 Cost-effective, Simple.

3.2 Coil Design Enhances Robustness

3.2.1 DD coils for lateral tolerance.

3.2.2 Larger Tx plate compensates.

Conclusion

4. Autonomous

    4.1 Selected Signal Strength Homing

        3.1.1 Range 3 - 5 m,

        3.1.2 Full autonomy achieved.

        3.1.3 Cost-effective, Simple.

References

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