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A Comprehensive Literature Review on On-The-Go Electric Vehicle Charging Systems

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Abstract: The growing adoption of electric vehicles (EVs) demands advanced charging technologies that eliminate range anxiety and reduce dependence on static charging infrastructure. This literature review explores the development of On-The-Go EV charging systems based on Dynamic Wireless Power Transfer (DWPT) technology. By embedding transmitter coils beneath road surfaces and integrating receiver coils in vehicles, DWPT enables continuous power transfer while the vehicle is in motion. This paper discusses existing research, standards, and prototypes, identifies the technological and infrastructural challenges, and highlights opportunities for future advancements in sustainable and intelligent transportation systems.
Keywords: Electric Vehicle (EV), Dynamic Wireless Power Transfer (DWPT), On-The-Go Charging, Resonant Inductive Coupling, Smart Transportation.

I. INTRODUCTION

Electric vehicles (EVs) have emerged as a promising solution for reducing greenhouse gas emissions and dependency on fossil fuels. However, their widespread adoption is hindered by challenges such as long charging times, limited range, and dependence on fixed charging stations. Conventional plug-in systems and static wireless charging pads require vehicles to remain stationary for extended periods, reducing overall efficiency. To address these issues, the concept of On-The-Go or Dynamic Wireless Power Transfer (DWPT) has been developed. This technology allows EVs to charge wirelessly while moving, using magnetic resonance coupling between transmitter coils embedded in the road and receiver coils mounted on vehicles. The system operates typically around 85 kHz, ensuring efficient energy transfer across an air gap and promoting seamless energy flow for smart transportation networks.

II. LITERATURE REVIEW

Extensive research has been conducted on dynamic wireless power transfer technologies aimed at achieving efficient and reliable energy transfer for moving vehicles. The fundamental principle relies on resonant inductive coupling, as introduced by Kurs et al., enabling mid-range wireless power transfer with minimal energy loss. SAE J2954 standards have defined operational frequencies, alignment techniques, and interoperability guidelines for wireless EV charging. Field trials conducted in Japan, Sweden, and the U.S. have demonstrated the feasibility of DWPT for public transport and logistics fleets. Companies like Electreon and Toyota have developed pilot systems to validate high-efficiency charging for moving vehicles. Research emphasizes energy efficiency optimization, safety measures against electromagnetic exposure, and integration of communication protocols such as ISO 15118 for vehicle-to-infrastructure (V2I) interaction. Several studies focus on infrastructure scalability, coil alignment accuracy, and segment-based road activation to minimize power loss. Recent advancements include the use of silicon carbide (SiC) power electronics and adaptive resonance control for improving transmission stability. Moreover, integration with renewable energy sources enhances the sustainability of DWPT systems, paving the way for eco-friendly transportation ecosystems.

III. EXPLORATION GAPS AND CHALLENGES

Despite significant progress, several challenges remain before large- scale perpetration of On- The- Go EV charging becomes doable. structure costs are high due to the need for bedding coils and power electronics in highways. Maintaining alignment between coils during vehicle movement affects power effectiveness. Electromagnetic field(EMF) safety and foreign object discovery are critical enterprises that must misbehave with ICNIRP and IEEE C 95.1 norms. also, standardization across different vehicle manufacturers and interoperability between charging systems remain open exploration areas. unborn studies must also address integration with renewable grids, dynamic billing mechanisms, and IoT- grounded monitoring for intelligent transport operations.

IV. CONCLUSION

On- The- Go EV charging represents a transformative step toward achieving sustainable mobility through nonstop energy transfer. This literature review highlights the advancements in DWPT technology, its functional mechanisms, and its integration with smart structure. While promising, unborn sweats must concentrate on reducing structure costs, icing system safety, and enhancing interoperability to realize its eventuality in smart metropolises and roadways. The combination of advanced accoutrements, effective power transformers, and IoT- grounded control systems will be crucial in enabling the coming generation of intelligent electric transportation.

V. ACKNOWLEDGMENT

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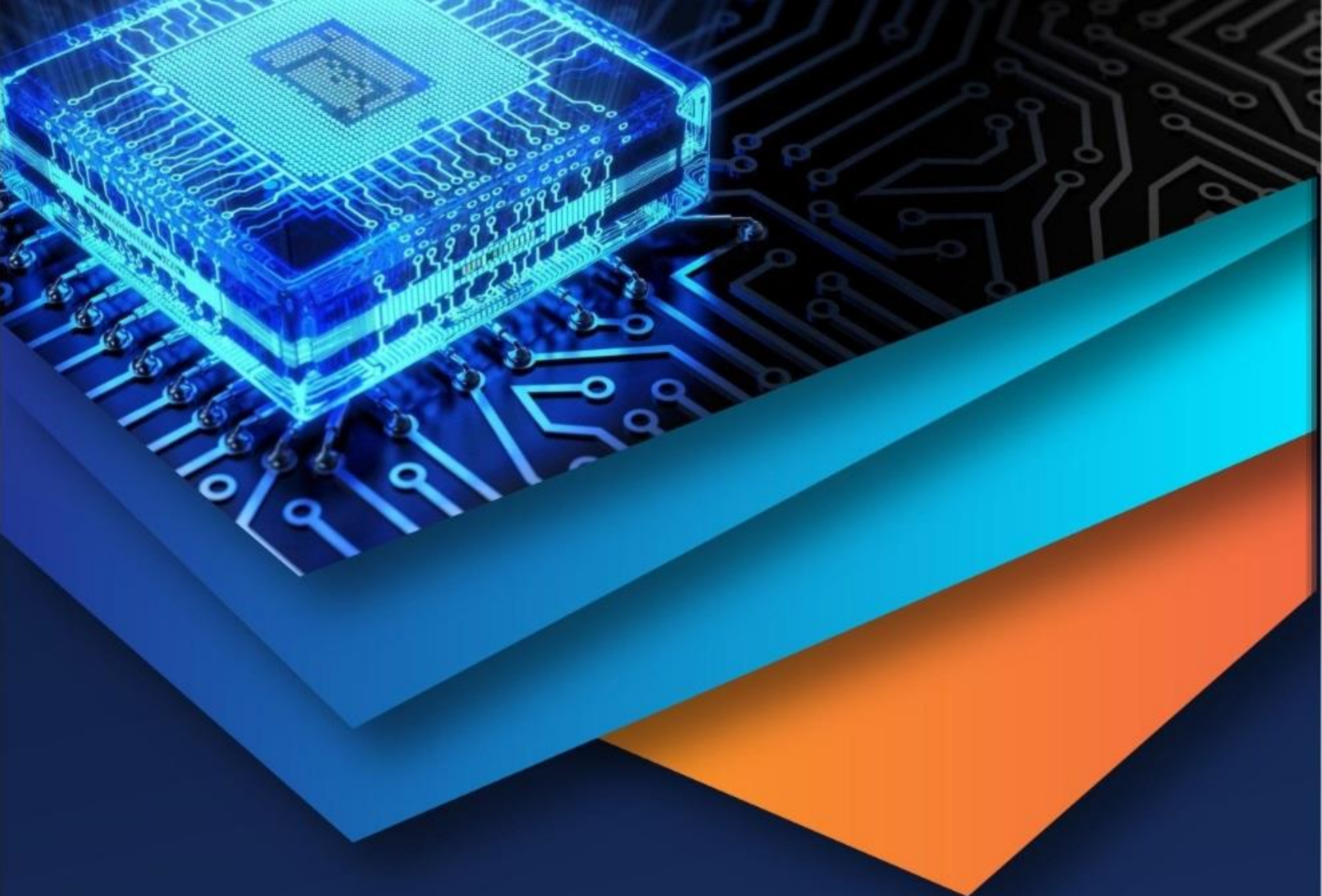

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