Solar Powered Wireless Charging for Electric Vehicles

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Abstract — This paper investigates the technological feasibility, efficiency metrics, and implementation challenges of integrating solar power combined with electric vehicle (EV) wireless charging technology. The research indicates that while solar-powered systems for wireless charging could achieve efficiency rates of up to 88.5% in optimal conditions, certain infrastructural and technological challenges must be addressed prior to their widespread use. In order to provide sustainable charging infrastructure, the research offers a thorough examination of existing technologies, implementation frameworks, and prospective solutions.

Keywords: Photovoltaic Systems, Electric Power, Wireless Charging, Solar, WPT Stands for Wireless Power Transfer

I. INTRODUCTION

While transitioning to electric vehicles is a significant advancement towards sustainable mobility, a substantial issue persists regarding the availability of accessible and environmentally friendly charging infrastructure. This study examines the potential integration combining solar power generation combined with wireless charging technology to tackle this issue. Electricity from the grid, which may still come from fossil fuels, is a major component of current EV charging systems. By doing away with the hassle of traditional plug-in systems, solar-powered wireless charging offers a chance to establish a charging environment that is genuinely sustainable.[1] Notwithstanding existing technical and infrastructural challenges, combining solar power with electric vehicle wireless charging technologies presents a viable solution for sustainable transportation infrastructure, capable of attaining high efficiency rates, reducing grid reliance, and enhancing user convenience.[2]

Electric vehicles (EVs) are a revolutionary concept in the worldwide transportation business. EVs are expected to grow significantly, accounting for 64% of light vehicle sales this year and 24% of the US fleet by 2030. To keep the quality of the power in the power grids, the charging process for EV batteries needs to be controlled in this situation. However, As electric vehicles gain prevalence, significant quantity of energy will be kept in the batteries, increasing the possibility of energy flowing in the reverse direction. Among the main technologies in smart grids of the future that will support the power grid's autonomous operation is interaction with EVs.[3] The idea of a bidirectional on-board charger that uses both V2G and V2H technologies is presented. Electric automobiles are currently more competitive than cars powered by conventional internal combustion engines because they use more fossil fuels and emit less carbon dioxide. Nevertheless, several disadvantages, for example, the car's expensive cost, stopped the EV from becoming widely available on the market. limited availability of all-electric drives and charging facilities. Electric cars are those that run completely on electricity or in part on electricity.[4] Electric vehicles are particularly ecologically friendly since they consume little or nonexistent the usage of fossil fuels move less components that must be kept up, which lowers their operating expenses. In earlier ten years, investigation and creation the number of electric vehicles has been prompted by the ongoing climatic situation. When the charging is done while the car is how long does it take to drive to wait at the charging station while the battery is being charged will be significantly reduced.[5]

The electrical automobile charging system is still under development due to several concerns such as infrastructure, cost, and safety. This study intends to provide a prototype of a dynamically wireless electric car solar-powered charging system that might be useful in the future. Consequently, the transformer is utilized to lessen the AC source voltage before a rectifier circuit converts it to DC. This voltage is transformed into AC voltage with the desired frequency using an inverter. The system's transmitter coil, which is installed on the base unit, receives the voltage at the required frequency.[6] This base unit will be positioned on the road when dynamic wireless charging is used. The receiver unit is positioned on the car's base, and the receiving coil receives electricity from the transmitter coil. After that, the power is changed and managed to match the battery parameters. It is through this that the battery gets charged. Keep it to yourself. This system offers EVs as an electric energy source near the location of electricity generation, which helps to enhance the rate of renewable energy usage, lower transmission network congestion, and lower power transmission losses.[7] To sum up, solar-powered wireless charging stations for EVs provide drivers with a practical, effective, and ecologically sustainable option. These stations enhance energy autonomy, diminish greenhouse gas emissions, and improve the driving experience by utilizing the capabilities of sunshine and cutting-edge wireless charging technology. Drivers may benefit from a smooth and practical charging experience if solar-powered wireless Charging station combine with alternative renewable energy sources and electric vehicle charging networks. It's probable that new business and job possibilities may arise as the need for these stations keeps increasing. [8]

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II. METHODOLOGY

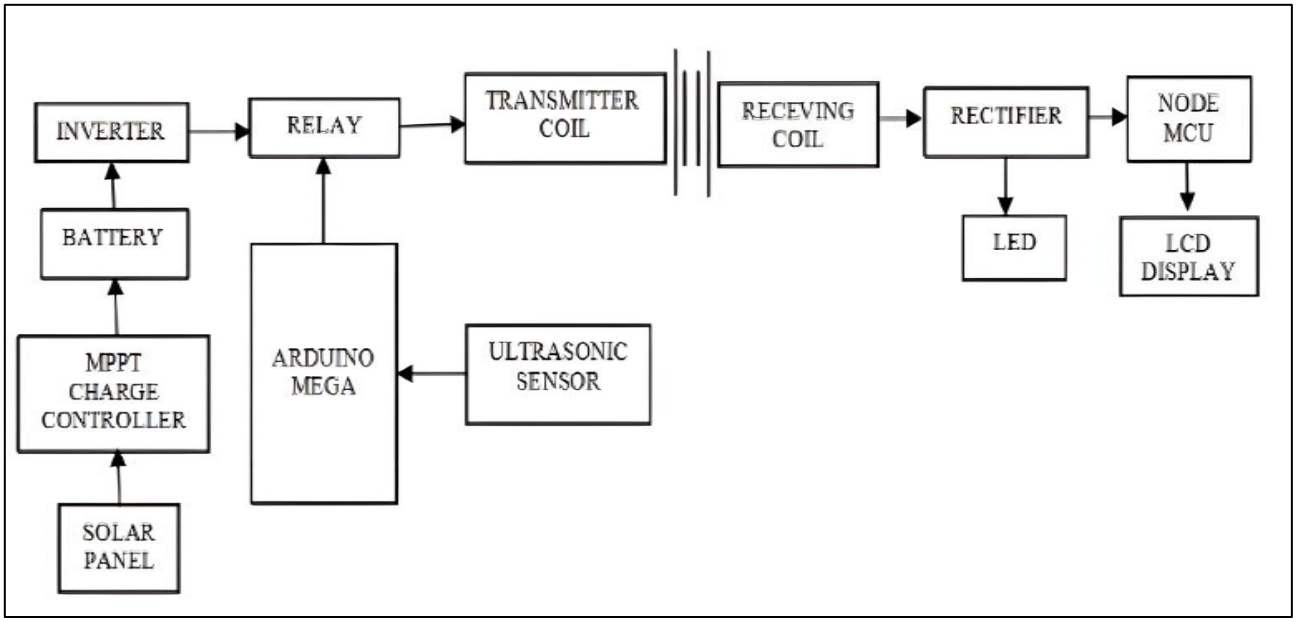

Fig. 1: Block Diagram of Solar Electric Vehicle Powered Wireless Charging

By examining the constituents in greater detail, the functioning of solar-powered wireless charging technology for electric vehicles may be better understood. The solar panels' direct current (DC) power is converted into alternating current (AC) electricity using an inverter. After that, the transmitter coil receives the AC power and creates a magnetic field. The vehicle's receiver coil then absorbs the magnetic field and transforms it back into AC power. A rectifier is then used to transform the AC current back into DC electricity, which is then utilized to charge the car's battery. The efficiency of the coils of the transmitter and receiver, the inverter, and the solar panels are a few elements that determine how effective the solar-powered wireless charging technology is. Coils, inverters, and high-efficiency solar panels can all increase the system's efficiency. To further enhance the system, the coils of the transmitter and receiver configurations and the AC energy frequency may be altered. The removal of wires and plugs is among the primary benefits of Solar-powered electric car wireless charging.

Solar energy, a sustainable and renewable energy source, powers the system. Thus, emissions of greenhouse gases are decreased together with dependence on fossil fuels is lessened. Furthermore, the technology may be used to charge electric cars in isolated locations with little access to conventional charging infrastructure. Nevertheless, solar-powered for electric vehicles, wireless charging is not without its difficulties. Efficiency is among the primary issues, the system, which is influenced by how successfully the the solar panels, the inverter, and coils for the transmitter and receiving work. Furthermore, a large surface area of solar panels is required for the system to generate enough energy to replenish the car's battery. As a result, the approach could be more costly than conventional charging methods. Another challenge for solar-powered electric vehicle wireless charging is system compatibility. The system's demand for a consistent interface between the coils of the transmitter and receiver may be challenging to meet. Establishing the standardized protocol required by the system for communication between the transmitter and receiver coils can also be challenging. An eco-friendly way to charge EVs is using a solar wireless electric car charging system, which combines wireless technology with solar energy. The initial part of this system is the purpose of solar panels is to collect sunlight and convert it into electrical energy. Direct Current (DC) electricity generated by solar panels can be used immediately to charge the vehicle or saved in a battery for use later, such as at night or when there is no sunshine. The Maximum Power Point Tracking (MPPT) system is a controller that ensures the solar panels produce the most energy possible. This controller modifies the panels' power output to correspond with external factors like temperature and sunshine intensity.

- Efficiency of solar-to-electrical conversion: up to 22.6% using commercial PV technology as of right now.
- Under ideal circumstances, wireless power transmission efficiency ranges from 80 to 95 percent.
- At 300W of output power, experimental prototypes achieved 88.5% system efficiency overall.
- Charging current capability: Prototype systems have shown up to 5A.
- Electricity delivery: Wireless charging devices that can dynamically supply electricity while a car is moving
- Connecting to the existing infrastructure: Energy storage devices and the smart grid systems are compatible.

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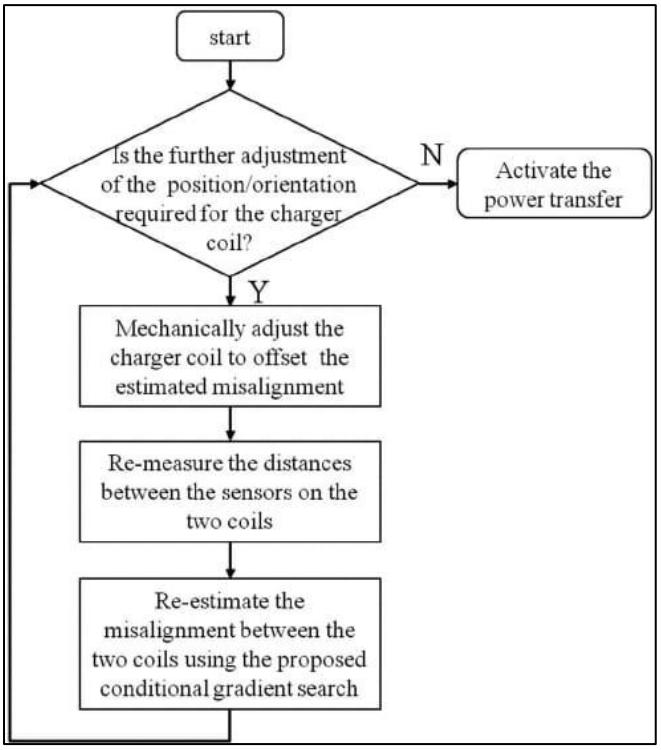

Fig. 2: Flow chart of wireless charging

III. Results and Discussion

Fig. 3: The Model of Solar Electric Vehicle Wireless Charging with Power

A wireless charging alternative for electric vehicles that runs on solar power automobiles uses photovoltaic panels to gather sunlight and convert converting it into electrical power. This energy is wirelessly transferred to the car using electromagnetic induction, removing the necessity of physical ties. The system includes an array of solar panels, a power conversion device, wireless charging transmitter, and a receiver fitted in the car. When the car is parked near the transmitter, energy is wirelessly sent to charge the battery. A wireless charging device for electric vehicles that runs on solar power automobiles offers convenience, efficiency, sustainability, and cost-effectiveness. It harnesses renewable solar energy, reduces the vehicle's carbon footprint, and reduces the necessity of traditional fossil fuel-based infrastructure for charging. The system may be scalable, modular, and simple to set up and maintain. Additionally, it may make money by selling extra energy back to the grid.

Solutions for wireless charging electric cars that run on solar power appear to possess a bright future, with many companies and researchers working on developing more efficient and cost-effective systems. Sustainable and effective charging options are becoming more and more necessary with the need for electric cars rises. The technology is continuously changing with researchers working on increasing effectiveness increasing wireless transmission distance, and reducing costs. As technology advances, widespread adoption of solar powered EV wireless charging systems is expected.

IV. Conclusion

An exciting development in environmentally friendly transport infrastructure is solar-powered wireless power supply for EVs. The Studies show that although there are still obstacles to general adoption, existing technology can attain high efficiency rates and useful charging capabilities. Future advancements in energy storage systems, wireless power transfer, and solar technologies should enhance system functionality and financial feasibility. As this technology develops further, it may be able to reduce reliance on conventional grid infrastructure and hasten the adoption of electric cars. Solar-powered wireless charging systems have the potential to become a commonplace component of future transportation infrastructure as the technology advances and costs fall down, providing a genuinely sustainable answer to the charging requirements for electric cars.

V. Future Scope

Wireless charging for electric vehicles (EVs) driven by the sun has an exciting and quickly developing future. The way we charge our cars might be revolutionized by this technology, becoming more sustainable, eco-friendly, and convenient. Wireless charging can aid in lowering emissions of greenhouse gases and dependency regarding fossil fuels by integrating solar electricity, which will encourage a broader usage of electric vehicles. We may anticipate increases in power production, efficiency, and range as the technology develops further. As a result, the feasibility and efficacy of wireless charging will increase, allowing Electric vehicle owners to swiftly and conveniently charge their cars. Our understanding of charging infrastructure will also be completely transformed by the creation of dynamic wireless charging technologies, which enable EVs to be charged while moving.

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