Solar Powered Static Wireless Charging System for Electrical Vehicle

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ABSTRACT: Day by day transportation sector moves toward electrification, efficient and accessible charging solutions for electric vehicles (EVs) are becoming essential. To eliminates energy shortages and environmental concerns, the motivation for renewable energy like solar power is increasing. Solar energy is freely available and can be efficiently converted into electrical energy using photovoltaic (PV) panels. Integrating solar energy with EV charging stations reduces the load on the power grid and promotes sustainability. One of the most effective ways to charge EVs is through wireless charging. A solar-powered wireless EV charging system operates independently of the power grid, reducing construction costs and allowing for flexible installation locations. This system utilizes Magnetic Inductive Coupling technology that enables wireless power transfer between two devices using electromagnetic induction. In this method, a primary transmitter coil generates a magnetic field, which induces a voltage in a secondary receiver coil in the receiver. A direct current (DC) power source, like solar panel, provides electricity to the primary coil, which create a magnetic field. This field transfers energy wirelessly to the secondary coil, where the induced voltage is rectified into DC power to charge the EV. This system offers a cost-effective, maintenance-friendly, and environmentally friendly solution for the growing EV market.

KEYWORDS: Photovoltaic, wireless power transfer, magnetic Inductive Coupling, electric vehicle charging, Renewable energy.

1. INTRODUCTION

The growing concerns about climate change and the depletion of fossil fuels have accelerated the shift towards electric vehicles (EVs). As EVs provide significant environmental benefits, their extensive adoption depends on overcoming key challenges like range anxiety and the availability of charging infrastructure. This explores the development of a solar-powered static wireless charging system as a potential solution to these issues. Wireless charging technology, combined with solar energy a efficient and renewable resource offers a promising way to improve the convenience and sustainability of EV charging. By eliminating physical cables and plugs, wireless charging provides a hassle-free experience for users. Additionally, integrating solar power into the charging infrastructure reduces dependence on the electricity grid and carbon footprint associated with power generation.

A Solar Powered Static Wireless Charging System offers a modern solution that combine energy with wireless charging technology, providing a clean, efficient, and hassle-free way to charge EVs. The Solar Powered Static Wireless Charging System indicate a significant move towards eco-friendly transportation solutions and reducing carbon emissions.

2. PROPOSED SYSTEM

The proposed system consists of Solar Power Generation Unit which consist of photovoltaic panel captures the sunlight and transform into electricity. Energy Storage System (ESS) which consist of A Battey which capture solar energy to keep functioning even in the absence of solar. Power Electronics consist of DC-DC converters and inverters regulate and maximize the power flow to ensure efficient power transfer. Wireless Power Transfer (WPT) System Uses inductive coupling to wirelessly transfer electricity from the charging pad to the EV battery. Control System Regulates the flow of power and energy, maximizes charging efficiency, and operates the system safely and efficiently.

2.1 Block Diagram

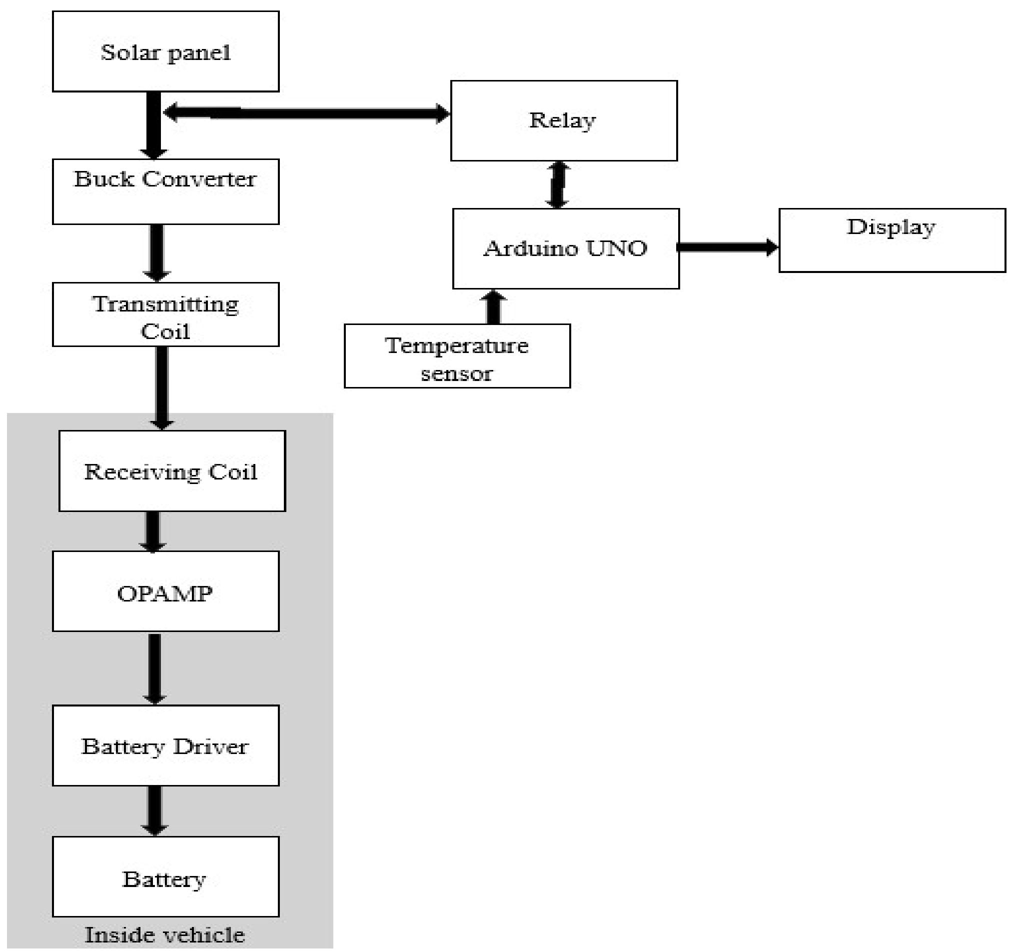

Fig 1: Block diagram of Solar powered Static Wireless Charging System for Electric Vehicle

2.2 Connection Diagram

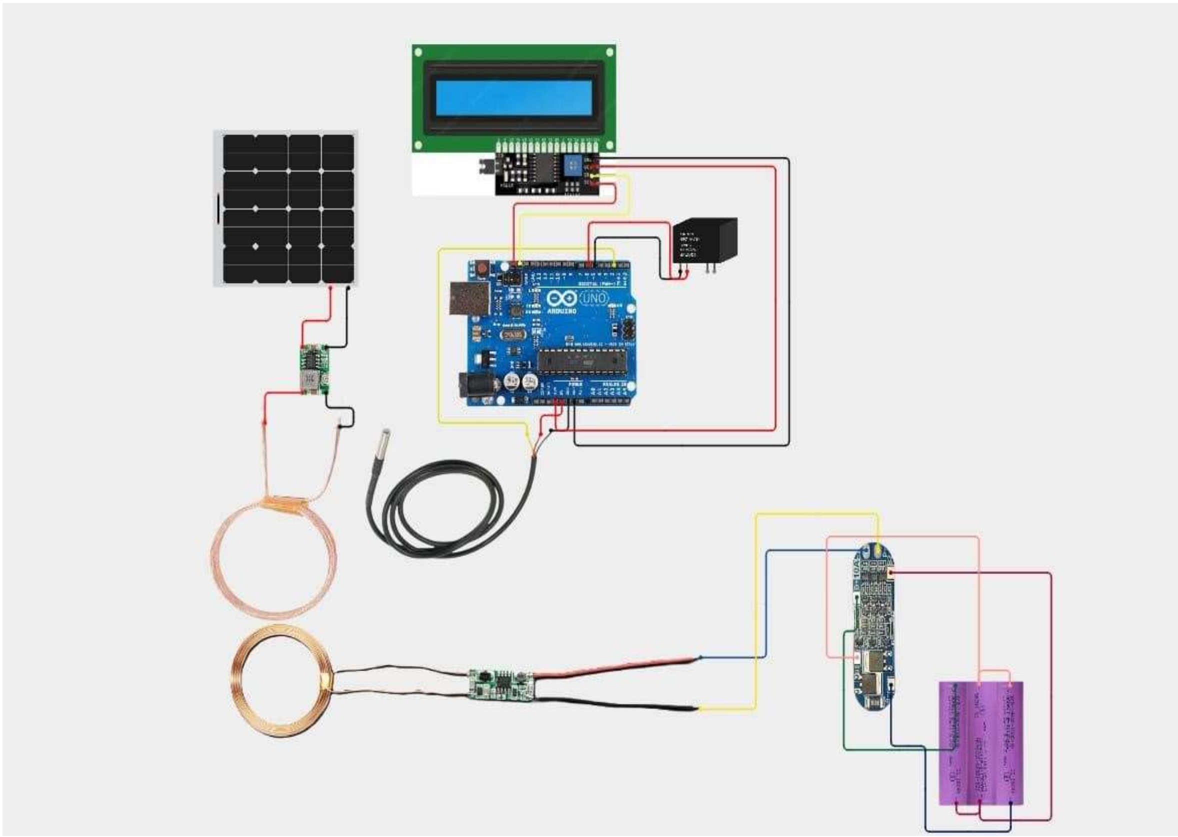

Fig 2 : Connection Diagram of Solar powered Static Wireless Charging System for Electric Vehicle

2.3 Working

In this system a solar-powered wireless charging system designed to charge a vehicle battery. It works on solar energy to generate electricity and then wirelessly transferring that energy to the battery which is located inside the vehicle. The system also includes a temperature sensor and a display to monitor the charging process.

First, the solar panel collects sunlight and converts it into electricity. Since the power from the solar panel may not be at the correct voltage, hence a buck converter is used to regulate the voltage to a safe limit. This regulated power is then sent to a transmitting coil, which creates a magnetic field. Inside the vehicle, a receiving coil cached this magnetic field and converts it into electrical power. However, this power may not be stable enough for the battery. To fix this, an operational amplifier (OPAMP) is used to stabilizes the power before sending it to the battery driver. The battery driver ensures that the battery gets the right amount of power for safe and efficient charging. The battery then stores this energy for use in the vehicle. To make the system safer, a temperature sensor is included to monitor heat levels. If the system gets too hot, the Arduino UNO microcontroller receives data from the sensor and can turn off the charging process using a relay. The Arduino also sends important information, like temperature and charging status, to a display , so users can see what's happening in real time.

This system provides a wireless and eco-friendly way to charge vehicle batteries. It eliminates the need for cables, making charging easier and safer. The temperature sensor and automatic controls help prevent overheating, ensuring that the battery charges efficiently without any risks.

3. HARDWARE SETUP

3.1 Sensors and Components

1. Sensor: The DS18B20 temperature sensor is used in this project to monitor the platform's temperature. It is a digital sensor known for its precision, reliability, and seamless compatibility with microcontrollers like Arduino. The temperature readings are displayed on an LCD screen or display module for real-time monitoring. If the platform's temperature rises above a set threshold, the Arduino activates a relay to either cut off or adjust the power supply, ensuring safe operation.

2. Solar Panel: The solar panel is designed to produce 20 watts of power under ideal sunlight conditions. It operates with a maximum voltage (Vmp) of 19.5V and a maximum current (Imp) of 1.044A. In this system, the solar panel serves as the main power source for charging the EV battery. It captures sunlight and converts it into electrical energy, which is then used to charge the battery. This process is made possible by photovoltaic (PV) cells, which transform solar energy into electricity, enabling efficient battery charging.

3. Lithium-Ion Battery Pack: The Lithium-Ion Battery Pack used in this project is a 3S 2200mAh, 11.1V battery. The "3S" configuration means the battery pack is made up of three lithium-ion cells connected in series. Each of these cells has a nominal voltage of 3.7V, so when combined, the total nominal voltage of the pack is: 3 × 3.7V = 11.1V When fully charged, each cell reaches 4.2V, meaning the total voltage of the battery pack at full charge is: 3 × 4.2V = 12.6V .So, this battery pack operates at 11.1V under normal conditions and 12.6V when fully charged.

4. Battery Driver (BMS): The 3S 10A Lithium-Ion Battery Management System (BMS) is a main component in this project which responsible for regulating and improving battery performance. It ensures that the battery is charged safely by supplying the appropriate voltage and current. Additionally, it controls the smooth and efficient transfer of power from the receiving coil to the battery, helping to maintain optimal performance.

5. Arduino: The Atmega328P-based Arduino as the main control unit responsible for processing data and managing system operations. The Arduino collects data from the system and displays it on a 16×2 LCD screen. It acts as the central controller, ensuring smooth communication between sensors and the relay module. The Arduino is programmed using the Arduino IDE, where the code is written in C++. Once uploaded to the board, the program executes and controls the entire system efficiently.

6. Transmitting and receiving coil: A DC power source is connected to a transmitting coil. When DC current flows through this coil, it creates a static magnetic field around it. A receiving coil is placed within the range of this magnetic field. This magnetic field induces a voltage in the receiving coil, which can then be used to power devices or systems.

3.2 Hardware Model

The image shoes the hardware model of a solar-powered static wireless charging system for electric vehicles. In the setup, a solar panel is connected to the transmitting coil, enabling wireless power transfer. An Arduino is integrated into the system, which is linked to a temperature sensor to monitor the platform's temperature. Additionally, the Arduino is connected to a relay, which automatically trips if the platform temperature exceeds a certain limit, ensuring safety.

Fig 3: Hardware setup of the Solar Powered Static Wireless Charging System for Electric Vehicle

4. RESULT AND CONCLUSION

4.1 Result

In this Study, our concern is to charge the Battery by wireless Power Transfer Process without the need of physical plug in of any cable. For these purpose in this model, we using the 3S 2200mAh, 11.1V lithium-ion battery pack which is the vehicle. The charging is fully based on the renewable energy source, the primary Source of energy in this system is Solar Energy. The Battery is Charge only using the the electricity produce by the solar Panel. The generated power is transferred Wirelessly by using the Transmitting coil which is mounted on the Platform and Receiving coil which is placed on the Vehicle.

While Charging the Battery observation taken which is shown at below:

Table 1: voltage of the Battery when the Charging is ON

Sr.No	Observtion	Battery voltage(volts)
1	When the Battery is discharged (Only 10 to 20 percent charge in Battery)	9.6V
2	At the middle of the Charging Process (after 30 min)	10.4V
3	When the Battery is charged (After 1 hour)	12.1V

4.2 Conclusion

Solar Powered Static Wireless Charging System for Electric Vehicle is proposed in this paper. The system has only one Source of energy which is solar energy which get converted into electricity to charge the vehicle Battery. The energy is then get transfer by the transmitting coil, which is mounted on the platform, and by the inductive power transfer the power is transmitted into the receiving coil, which is placed inside the vehicle. The received power fed to the battery in the vehicle to charge the battery, through a battery driver. An Arduino UNO is incorporated in the system to sense temperature throw a temperature sensor, regulate power flow via a relay, and show system status on display. Wireless power transfer adds convenience and safety, while solar power provides sustainability. Thus, system provide a innovative and sustainable charging solution for the Electric Vehicle Charging.

5. Future Scope

The future scope of this wireless vehicle battery charging system is vast, with potential advancements in efficiency, automation, and scalability. The addition of AI-based monitoring can optimize power management, ensuring faster and safer charging while extending battery life. Furthermore, IoT connectivity can use to provide remote monitoring and control through mobile apps, enabling users to monitor battery health and charging status in real-time. The system can also be designed to handle the multiple charging, which make it applicable for public electric vehicle charging system.

6. REFERENCE

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