



SOLAR ROOF TOP WIRELESS CHARGING STATION FOR ELECTRICAL VEHICLES

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Abstract: The transition to electric vehicles (EVs) is critical for reducing greenhouse gas emissions and mitigating climate change. To support this transition, the development of efficient and accessible charging infrastructure is paramount. In this project, we propose a solar rooftop charging station for EVs, integrating renewable energy sources to power vehicles sustainably. The system utilizes Arduino-based control mechanisms to manage power flow and ensure optimal charging performance. By harnessing solar energy, this solution not only reduces reliance on grid electricity but also promotes eco-friendly transportation. The integration of Arduino technology enhances flexibility and scalability, making it adaptable to various environments and user needs.

Keywords: Electric vehicles, Solar power, renewable energy, eco-friendly, grid electricity

1. INTRODUCTION

As society embraces the imperative of reducing carbon emissions, electric vehicles (EVs) have emerged as a pivotal component of sustainable transportation solutions. However, the widespread adoption of EVs relies heavily on the development of efficient and accessible charging infrastructure. Traditional charging stations often require physical connectors, limiting convenience and scalability while contributing to cluttered urban landscapes. To address these challenges, wireless charging technology presents a compelling alternative. By enabling power transfer without direct physical contact, wireless charging systems offer greater flexibility and convenience for EV users. Moreover, integrating renewable energy sources such as solar power into wireless charging infrastructure enhances sustainability and reduces reliance on grid electricity. In this project, we propose a solar rooftop wireless charging station for EVs, leveraging the capabilities of Arduino-based control systems. The system comprises photovoltaic (PV) panels installed on rooftops to harness solar energy efficiently. This not only streamlines the charging process but also reduces wear and tear on charging equipment, enhancing durability and reliability. Key components of the system include PV panels, wireless charging coils, Arduino microcontrollers, and power management modules. These components work in synergy to deliver a seamless and eco-friendly charging experience for EV users. The integration of Arduino-based control systems adds a layer of intelligence to the charging station, allowing for dynamic adjustment of charging parameters based on factors such as solar availability and battery status. By combining renewable energy sources with wireless charging technology and Arduino-based control systems, this project exemplifies the convergence of innovation and environmental stewardship in addressing the challenges of modern mobility.

2. LITERATURE SURVEY

A solar charging station for electric cars using a solar panel array and a power conditioning device to convert solar energy into electrical energy was proposed by Bugatha Ram Vara Prasad et al. in 2021. To control the charging procedure and maximize the use of renewable energy sources, the system integrates an energy management system. The performance and efficiency of bipolar pads for wireless power chargers were assessed in a feasibility study by T.D. Nguyen et al. (2020). The study emphasizes how bipolar pads might help lessen the need for physical connections when it comes to wireless charging. A bidirectional battery charger was created by Bugatha Ram Vara Prasad and K. Aswini (2021) to enable effective charging and draining of electric vehicle batteries. A battery management system is part of the system to control charging and guarantee peak performance. A real-time coordination system for electric cars at the distribution substation level was proposed by M. Singh et al. (2019). It uses sophisticated algorithms and a communication network to control charging and discharging. By using renewable energy sources more efficiently, the system lessens dependency on the electrical grid. They transferred power using inductive coupling. Adel El-shahat et al. (2019) covered the



fundamentals of wireless charging for electric vehicles as well as several approaches, with an emphasis on inductive power transmission. They provided details on a high-efficiency inductive wireless power transfer prototype. The tactics for charging electric vehicles were further developed by A.M. Alsomali et al. (2017), who used temporal multiplexing to shorten the charging time and pulse width modulation to control voltage. (2019) A solar-powered electric car charging module with an MPPT controller to measure maximum power generation and an Internet of Things device to monitor maximum power availability was launched by Akila.A, Akila.E, and Anu.K in 2019. Their system uses an Arduino UNO R3 to display power distribution and 29 International Journal for Modern Trends in Science and Technology battery level on an LCD panel. It also has a web page for station location and charge availability, as well as a GSM modem for alarm messages. Their study attempts to lower the use of fossil fuels and greenhouse gas emissions.

3. PROPOSED SYSTEM

The proposed system for a solar rooftop wireless charging station for electric vehicles is designed to integrate renewable energy generation with efficient wireless power transfer technology. In this system, solar photovoltaic panels installed on rooftops capture sunlight and convert it into electrical energy, which is then regulated using a charge controller and either stored in a battery system or directly supplied to the charging unit. The wireless charging mechanism operates based on electromagnetic induction or resonant inductive coupling, where a transmitter coil embedded in the charging pad generates an alternating magnetic field. A corresponding receiver coil mounted underneath the electric vehicle captures this energy and converts it back into electrical power to charge the battery. The system also incorporates power electronics such as inverters, converters, and control circuits to ensure stable and efficient energy transfer. Additionally, a smart monitoring and control unit can be included to manage energy flow, track performance, and optimize charging based on solar availability and vehicle demand. This proposed system aims to provide a sustainable, contactless, and convenient charging solution for modern electric vehicles.

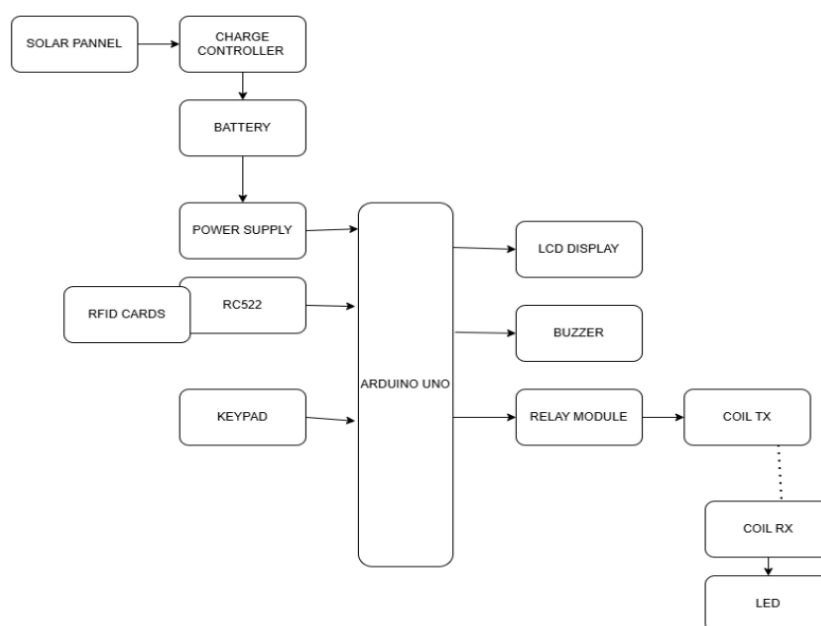


Fig. 1: Proposed System

In proposed model we are generating electric source of energy by combination of electrical source of energy i.e. solar energy which is able to meet the load demand and load requirements for different applications. This equipment is developed on present day scenario. The solar energy are intertwined together in the system and the energy produce by both the power generators are stored in a battery. This model is built in such a way that a common man can afford and this project will lead a step ahead for economic utilization. By using this proposed system we can able to operate domestic loads effectively without any interruption.

4.METHODOLOGY

The methodology of a solar rooftop wireless charging station for electric vehicles involves a systematic process of energy generation, conversion, transmission, and utilization. Initially, solar photovoltaic panels installed on the rooftop capture sunlight and convert it into DC electrical energy. This energy is regulated using a charge controller to maintain stable



voltage and prevent overcharging, and is either stored in batteries or supplied directly to the system. The stored or regulated DC power is then converted into high-frequency AC using power electronic converters and inverters, which is essential for efficient wireless power transfer. The wireless charging process is carried out using inductive coupling, where the transmitter coil generates an alternating magnetic field and the receiver coil in the vehicle captures this energy. The received power is then rectified and filtered back into DC form to charge the vehicle's battery. Throughout this process, a control unit monitors parameters such as voltage, current, and alignment to ensure safe, efficient, and optimized charging. This methodology ensures a clean, contactless, and sustainable approach to powering electric vehicles using solar energy.

5. PROPOSED SYSTEM HARDWARE RESULTS

The Proposed System is Arduino is open source physical processing which is base on a microcontroller board and an incorporated development environment for the board to be programmed. Arduino gains a few inputs, for example, switches or sensors and control a few multiple outputs, for example, lights, engine and others. Arduino program can run on Windows, Macintosh and Linux operating systems (OS) opposite to most microcontrollers' frameworks which run only on Windows. Arduino programming is easy to learn and apply to beginners and amateurs. Arduino is an instrument used to build a better version of a computer which can control, interact and sense more than a normal desktop computer. It's an open-source physical processing stage focused around a straightforward microcontroller board, and an environment for composing programs for the board. Arduino can be utilized to create interactive items, taking inputs from a diverse collection of switches or sensors, and controlling an assortment of lights, engines, and other physical outputs. Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders.. Most RFID tags contain at least two parts. One is an integrated circuit for storing and processing information, modulating and demodulating a (RF) signal, and other specialized functions. The second is an antenna for receiving and transmitting the signal. Chip less RFID allows for discrete identification of tags without an integrated circuit, thereby allowing tags to be printed directly onto assets at a lower cost than traditional tags.

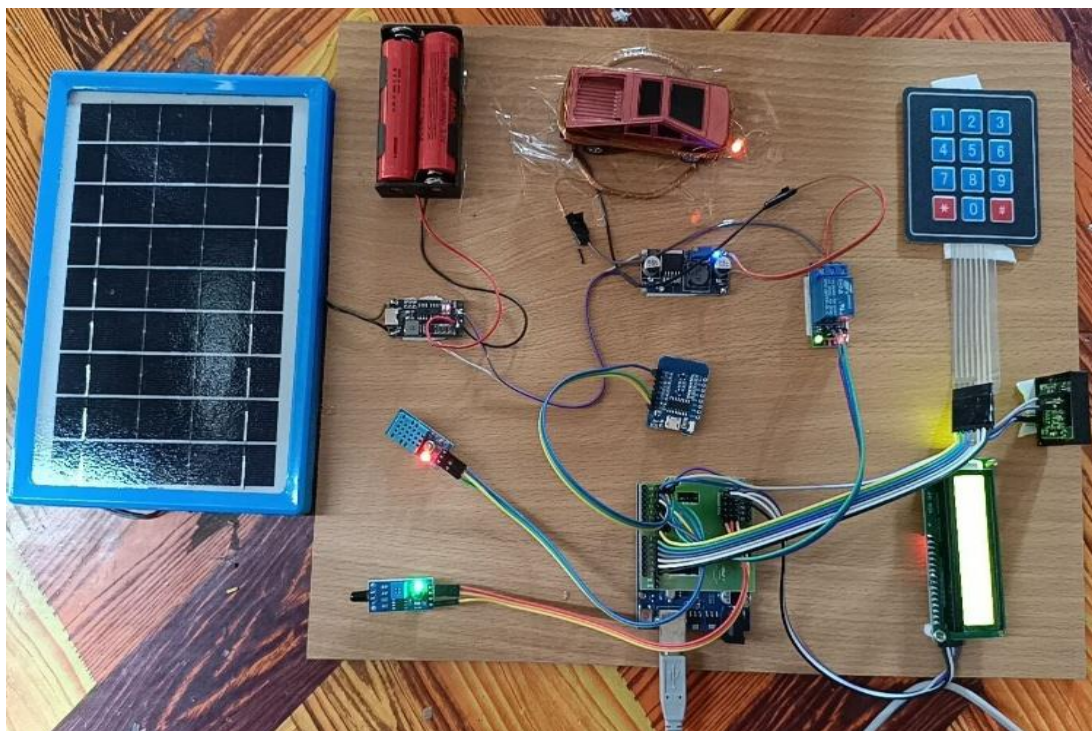


Fig. 2: Hardware Design



Fig. 3: Output of an Image

6.CONCLUSION

The development of a solar rooftop wireless charging station for electric vehicles (EVs) using Arduino-based control systems represents a significant advancement in sustainable transportation infrastructure. By integrating renewable energy sources with wireless power transfer technology, this project offers a convenient, eco-friendly, and scalable solution to meet the growing demand for EV charging. The use of Arduino microcontrollers facilitates real-time monitoring and optimization of the charging process, ensuring efficient energy management and reliable operation. Wireless charging technology eliminates the need for physical connectors, enhancing user convenience and reducing clutter in urban environments. Furthermore, harnessing solar energy for EV charging reduces reliance on grid electricity, contributing to carbon emission reductions and promoting environmental sustainability. The modular design of the system allows for scalability and customization according to specific requirements and site conditions.

5.1 The future scope includes the following:

Enhanced Efficiency: Continuous research and development efforts can focus on improving the efficiency of solar energy capture and wireless power transfer technology. Advancements in materials and design could lead to higher conversion efficiencies and faster charging rates, further enhancing the viability of solar rooftop wireless charging stations.

Smart Grid Integration: Integration with smart grid infrastructure can enable dynamic adjustment of charging parameters based on grid conditions, energy demand, and pricing signals. This would optimize energy usage and reduce strain on the grid during peak hours, while also providing cost savings for EV owners.

Battery Technology: Advances in battery technology, such as higher energy density and faster charging capabilities, could enhance the overall performance and usability of EVs. Compatibility with next-generation batteries would ensure that solar rooftop wireless charging stations remain relevant and efficient in the evolving landscape of electric mobility.

Expansion of Infrastructure: Continued expansion of charging infrastructure, including the deployment of solar rooftop charging stations in public spaces, residential areas, and along highways, would increase accessibility and convenience for EV users. Collaboration between government agencies, private companies, and communities is essential to accelerate the deployment of such infrastructure.

Integration with Autonomous Vehicles: As autonomous vehicle technology continues to advance, integration with solar rooftop wireless charging stations could enable seamless charging and maintenance of autonomous EV fleets. This would support the transition towards autonomous mobility solutions while further reducing the environmental footprint of transportation.

In summary, the solar rooftop wireless charging station for EVs presents a promising solution to address the challenges of sustainable transportation. Through ongoing innovation and collaboration, this technology has the potential to revolutionize the way we power and manage electric vehicles, paving the way for a cleaner and more sustainable future.

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