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Solar Wireless Electric Vehicle Charging System

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Abstract: This paper details the planning and design of a solar-powered charging for electric vehicles, a solution to the dual problems of expensive gasoline and harmful emissions. The number of countries with electric vehiclesontheroadissteadilyrising. Inadditiontohelpingtheenvironment,electricvehicleshaveproven useful in cutting down on transportation costs by substituting expensive fuel with much more affordable power. Here, we create a novel and effective answer to this problem by designing an electric vehicle charginginfrastructure. Thereisnoneedtostop forchargingbe causetheEVcandosowhileitisinmotion; the system is powered by solar energy; and there is no need for an additional power source. For its construction, the system employs a solar panel, battery, transformer, regulator circuitry, copper coils, AC to DC converter, atmega controller, and LCD display. This technology follows the ideology that charging electric vehicles can be done without having to pull over to a charging station. So, the technology proves the viability of a road-integrated, solar-powered wireless charging system for EVs.

I. INTRODUCTION

In the field of transportation, electric vehicles (EVs) represent a novel concept. Electric vehicles (EVs) are predicted to take over the automobile market in the near future. The charging procedure for electric vehicles (EVs) must be regulated in this context in order to preserve the quality of the power networks. In spite of this, with the growth of electric vehicles (EVs),there will be a significant quantity of energy stored in the batteries, which will allow for the opposite effect. EV interactivity will be important technology in future smart grids ,contributing to the autonomy of the power grid. Due to decreasing cardon dioxide emissions and rising fossil fuels, the electric vehicle has become more competitive than the conventional internal combustion engine vehicle. In spite of these drawbacks, the EV was not generally adopted in the market because of its high vehicle cost. There is a dearth of fast-charging stations and a paucity of all-electric vehicles. There are two types of electric vehicles: those that are powered entirely by electric power and those that are partially powered by electric power. In addition to their low operating costs and little impact on the environment, electric vehicle utilize little or no fossil fuel at all. Electric vehicles will be the primary means of transportation in the future to enhance charging efficiency [1]. When it comes to acquiring an electric vehicle, the absence of charger was tested by lowering charging time with renewable energy. A hybrid power system is used in this study to provide a unique service to long-distance EV drivers. Between major highways, there aren't any places for these drivers to refuel their automobiles with electricity. The wireless EV charger is a great choice for people who want to use electricity to charge vehicles[2]. Because of rising fossil fuel prices and declining CO2 emissions vehicles are now more cost-competitive than traditional Considered as a continuous vehicle. Electric vehicles were not extensively adopted because of restrictions such as high car costs[2]. There is a dearth of fast-charging stations and a paucity of all-electric vehicles. It is possible for EVs to be powered entirely or in part by electricity. Due to their lack of moving parts and little impact on the environment, electric cars have lower operating expense than gasoline-powered counterparts [3]. Our project system uses a solar panel, battery, transformer, regulator circuits, copper coils, AC to DC converter atmega controller, and LCD display to build the system. Ther is no need to stop for recharging with this system because to the solar panel. Dc electricity is being stored in the battery. Now , in order to send the DC power, it must be converted to AC power. A transformer is used here to accomplish this task.

II. LITERATURE SURVEY

In recent years, several innovative approaches have been introduced to advance the field of wireless electric vehicle (EV) charging, particularly with the integration of solar energy. These systems aim to promote sustainable transportation, improve energy efficiency, and reduce reliance on traditional charging infrastructure.Ram Vara Prasad et al. [1] proposed a solar wireless electric vehicle charging system that combines inductive power transfer with solar energy harvesting. The system aims to provide a wireless charging solution for EVs that eliminates the need for plug-in charging and leverages renewable energy. The research highlights the design of a solar panel array integrated with a wireless charging pad, which transfers energy through electromagnetic induction, thus improving convenience and reducing greenhouse gas emissions.In a related study, Ram Vara Prasad and Deepthi [2] designed a solar-powered charging station specifically tailored for electric vehicles.

Their setup focuses on efficient energy conversion using Maximum Power Point Tracking (MPPT) algorithms, enabling better performance even under varying sunlight conditions. The system provides a robust and scalable architecture for public EV charging infrastructure powered entirely by solar energy.The fundamental concepts of wireless power transmission, which are crucial for developing contactless EV charging systems, were reviewed by Singh et al. [3]. Their work gives an overview of the various technologies developed for wireless transmission of electrical power, including inductive and resonant inductive coupling, and discusses recent advancements and challenges in achieving efficient long-distance power transfer. This foundational research helps to contextualize ongoing improvements in dynamic wireless EV charging.A study by Javor et al. [4] explored the optimization of vehicle-to-grid (V2G) services with a focus on reducing battery degradation and minimizing electricity costs. This work emphasizes how bi-directional wireless charging systems could contribute to grid stability while balancing user economics and battery health, an important consideration for solar-integrated systems where intermittent generation is a concern.Kennedy and Price [5] investigated solar-selective coatings for high-temperature applications. Though not directly tied to EVs, their findings are applicable to solar EV chargers, particularly in improving thermal efficiency and energy capture for photovoltaic systems under high-heat conditions—enhancing the performance of solar arrays used in EV infrastructure.These studies collectively form a comprehensive foundation for the development of solar-powered wireless EV charging systems. They illustrate the integration of wireless transmission, solar energy, and smart energy management to create a more sustainable and user-friendly transportation ecosystem.

III. SYSTEM OVERVIEW

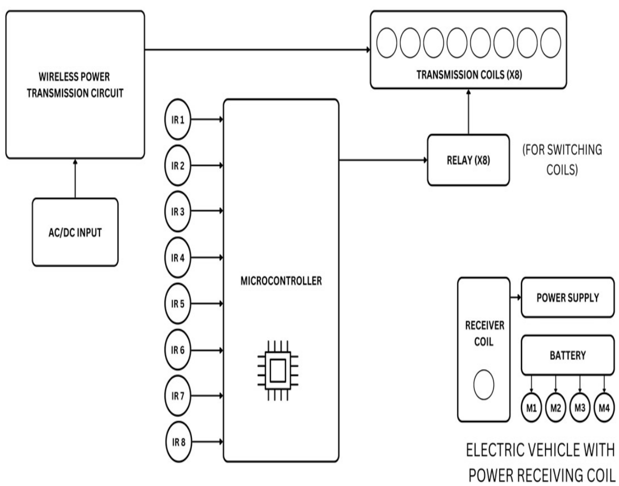

Fig. 1. BLOCK DIAGRAM

In the 19th century, the concept of power distribution for wireless lights before the idea of wireless power transfer for charging electric automobiles [17]. Using wireless power transfer (WPT) technology, we can now create power pads for wirelessly charging EVs. Power pad for EV charging issues, a major barrier for EV owners, are addressed by this technology. Wireless charging can be accomplished through magnetic induction or radio frequency, using a static or dynamic wireless power transfer system; in the former case, magnetic induction is used to power the charging pads, which convert electrical energy magnetic energy and enable transmission over an air gap, typically short to mid-range. Parabolic dishes are used to direct radio waves, which have a very great range, onto their intended target in the atmosphere using radio frequency (or microwave) technology shown in figure 1.9. The driver of a vehicle powered by a stationary wireless power transfer (SWPT) technique can simply park and depart, while the driver of a vehicle powered by a dynamic SWPT method can charge an electric vehicle (EV) while driving and switch lanes once the EV is fully charged. Dynamic wireless power transfer describes
this phenomenon (DWPT).

This paper aims to present a stable charging method for high-power applications by detailing advancements in a segmented dynamic wireless power transfer (DWPT) system for electric vehicles (EVs). For high-power applications, an integrated design is shown that takes into account the improved switching sequence, the reduced size of segmented transmitters, and the parallel inverter technology. Depending on where the pickups are, power is distributed to one of three adjacent transmitters installed on the rail. A Q-shaped coil, a DD-shaped coil, and another Q-shaped coil follow one another in this trio of transmitters (QDDQ) [18].

One way to minimize the impact of output voltage fluctuations and maximize the efficiency of the energized transmitters is to employ QDDQ as the elementary energized group. FEA is used for the complete DWPT system's design, and several circuit topologies are analyzed. Over all, the performance of a dynamic charging experimental prototype is verified, and it is found to be in close agreement with the theoretical analysis shown in 1.10. There are five transmitters and one receiver in this prototype. All measurements are in units of 500 millimeters. From a 100 to 200 load, the suggested system has been verified to achieve a constant output voltage of 500 V at an estimated 85% dc-dc efficiency. At a load of 100, the maximum output power is 2.5 kW.

IV. METHODOLOGY

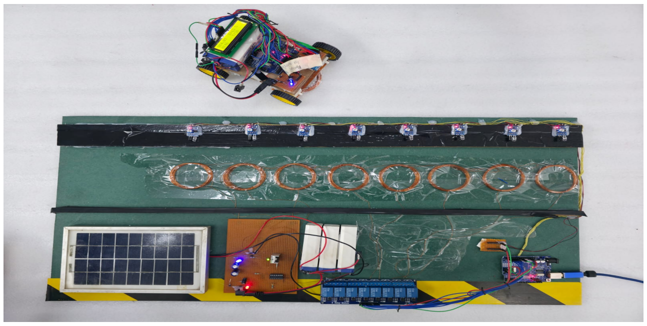

Fig. 2. PROJECT PHOTO

This project involves a multi-faceted approach combining wireless charging technology with IoT integration to create an efficient and user-friendly electric vehicle charging station. First, the design of the wireless charging system will be based on electromagnetic induction or magnetic resonance, ensuring efficient power transfer between the charging pad and the vehicle's receiver. IoT-enabled sensors will be integrated into both the charging station and the vehicle to monitor real-time data such as battery status, temperature, and energy consumption.

This data will be processed using a cloud-based platform, enabling real-time analytics and remote management. A mobile application will be developed to provide users with real-time charging updates, station availability, scheduling options, and payment functionalities. Smart energy management algorithms will optimize energy usage, ensuring that charging speeds are adjusted based on grid load, while also incorporating renewable energy sources where possible.

Communication protocols such as MQTT or Wi-Fi will allow seamless data exchange between the vehicle and the charging station, enabling features like automated billing and user authentication. A physical prototype of the system will be developed, followed by rigorous testing and simulation to ensure charging efficiency, IoT functionality, and system reliability. Finally, pilot testing will be conducted to gather user feedback and refine the system before large-scale deployment.

A. Problem Statement:

"As the world shifts towards sustainable transportation, electric vehicles (EVs) are gaining popularity. However, limited battery range and lengthy charging times hinder widespread adoption. Traditional wired charging methods require EVs to stop and plug in, reducing travel efficiency.

B. Key Challenges:

1) Limited driving range due to battery capacity constraints.
2) Inconvenient and time-consuming wired charging processes.
3) Insufficient charging infrastructure, particularly on highways.

C. Objective:

Design and develop an efficient wireless power transmission system integrated into roads to enable seamless, continuous charging of EVs while in motion, eliminating range anxiety and enhancing travel convenience."

D. Specific Requirements:

1) Wireless power transmission efficiency > 90%.
2) Charging capacity: up to 100 kW.

3) Compatibility with existing EV models.
4) Safety features to protect pedestrians and vehicles.
5) Scalability for widespread adoption.

E. Potential Benefits :

1) Increased EV adoption.
2) Reduced range anxiety.
3) Improved travel efficiency.
4) Enhanced road safety.
5) Reduced greenhouse gas emissions.

F. Reset System:

The resetSystem() function resets the relay, and LCD screen, indicating that the system is resetting and then returns to its normal operation.

G. In Summary:

There will be an increase in the use of electric vehicles and corresponding charging stations in the nearfuture.Theabilitytochargeelectricvehicleswillbecrucial.Thelackofawidespreadcharging network is the biggest obstacle to increasing EV demand in the market. We looked at the portable EV charger that uses renewable energy to shorten the recharging period for electric vehicles. The work presented herein presents a novel service to long-distance electric vehicle travelers using a hybrid power system for a vehicle battery charging station. However, there is a lack of convenient charging sites for drivers of electric vehicles along interstates and highways. To avoid plugging in, the wireless EV charger is the best option for charging their automobiles.

V. RESULTS AND DISCUSSION

Aninstructionalandresearchfocusedwirelesspowertransfer(WPT)systemonelectricvehicle(EV)charging.Basedoncoupledmagneticresonancetechnology,whichallowsforthetransferofpowerinthenonradiativenearfield,thesimulation.Thetopologyofastreamlinedpowertransfersystem is suggestedand put into practice. It is doneto simulateand analyze theproposed chargingscheme mathematically. Based on this architecture, simulation and analysis were done on the counter- electromotive force (counter EMF, CEMF) in the receiving coil in relation to constant transfer distance and driving frequency. Significant implications are drawn from the simulation analysis of thewirelesschargingsystem,andspecificdesignrecommendationsareoffered.Thesimulationcan be employed as a tool for additional investigation into WPT optimization for EVs.Itiscumbersome,costly,anddangerousto chargeanelectricvehiclebattery withachargerandwire. If drivers are to make long trips, electric vehicle charging stations must be available. A series of thesestationsmustbeplacedstrategicallytospanlargedistances.Additionally,rechargingabattery completely often takes three hours, which is a lot longer than the time required to refuel a gas- powered car. unsecured charging cords on the floor could be a tripping hazard. In colder climates, leakage from outdated, damaged cable may present the owner with additional concerns. The efficiency of wireless power transmission can be affected by variations in lateral distance and primary-secondary coil spacing. Anxiety about a car's range, or the concern that it won't have the power to reach certain distances

VI. CONCLUSION

Electric cars (EVs) are essential in the present when the environment has worsened so significantly. The government of plans to completely phase out diesel cars by the year 2030. Because waiting for an electric vehicle to charge is the biggest drawback to EV adoption, rapid charging technology and charging stations are essential to the widespread acceptance of EVs. A reliable charging network will be essential to the success of this shift.

The broad adoption of EVs has the potential to significantly disrupt the reliability of the power grid. A renewable energy system is at the heart of the "solar-based wireless EV charging" initiative. A lead-acid battery stores the electricity generated from the sun. The BMU allows for the installation of a completely wireless charging infrastructure. This saved power is used to refuel EVs.

VII. ACKNOWLEDGMENT

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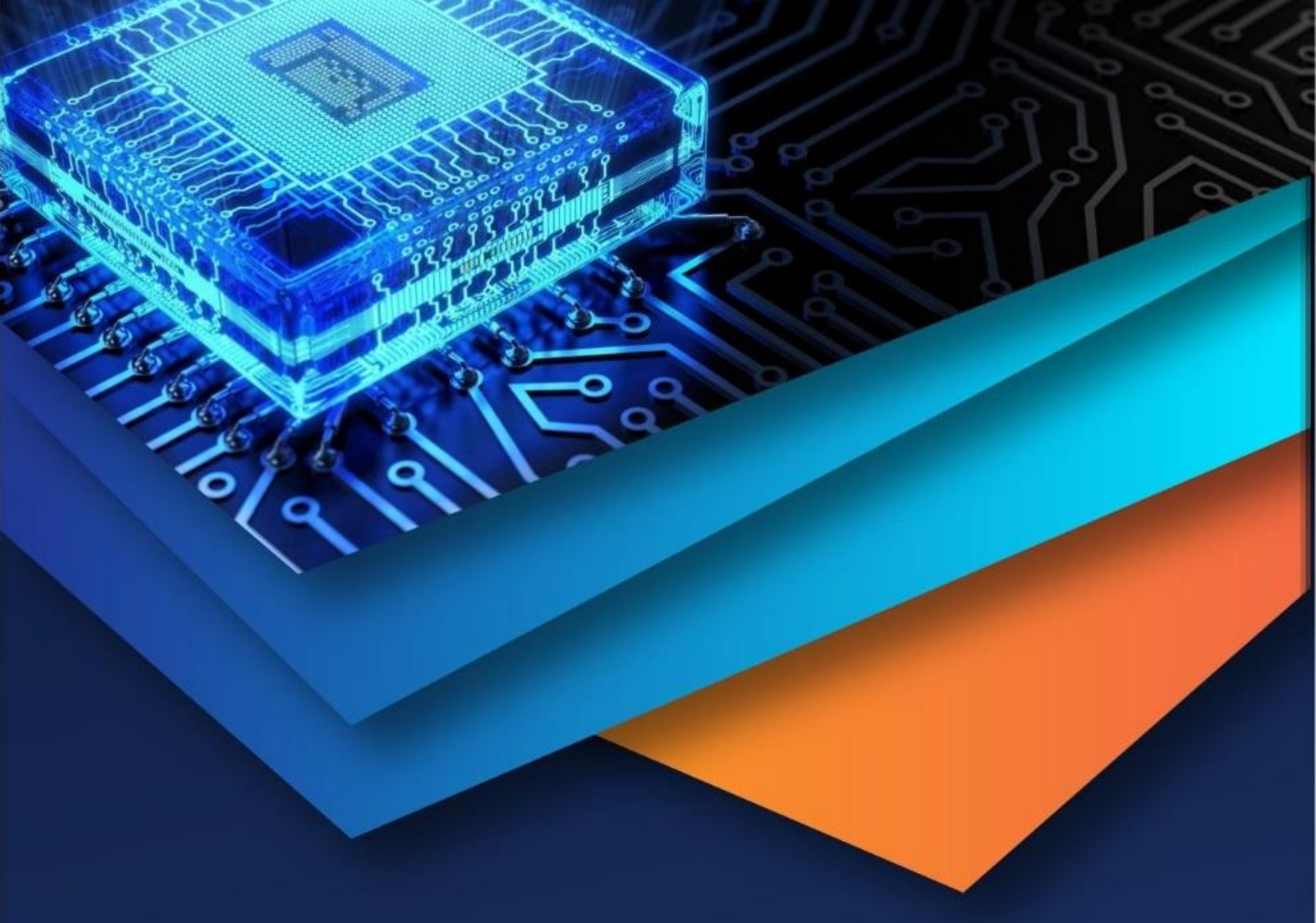

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