A Implementation of Solar Based Wireless EV Charging System

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Abstract: In our rapidly declining environment, the need for electric vehicles (EVs) has become essential. The Indian government aims to transition to exclusively electric vehicles by 2030. However, a significant barrier to widespread EV adoption is the lengthy charging time, necessitating the development of fast-charging solutions and robust charging infrastructure. An adequate charging network is crucial for this transition. With the increasing use of EVs, the current power supply could face significant instability. The "solar-based wireless EV charger" technique addresses this challenges by utilizing renewable energy technology. In this system, solar energy is converted into electrical energy and stored in a lead- acid battery. A battery management unit then facilitates a wireless charging system, allowing the stored energy to be used for charging electric vehicles.

Keywords: Solar panel, BMS, Wireless Charging coil, ESP8266, IOT Monitoring, Relay Module.

I. Introduction

To enhance the efficiency of charging stations, it's essential to recognize that electric vehicles (EVs) represent the future of transportation. A significant factor influencing the demand for EVs is the availability of charging infrastructure; currently, the lack of such facilities is a primary reason deterring potential buyers.In our research, we explored the concept of a portable EV charger that utilizes renewable energy to reduce charging times. The vehicle battery charging station developed in this work employs a hybrid power system, offering a unique service to travelers aiming to cover long distances in electric vehicles. Notably, there is a scarcity of electric charging stations along highways, making it challenging for such users to recharge their vehicles. For these travelers, a wireless EV charger presents an ideal alternative.This approach aligns with ongoing advancements in wireless charging technologies. For instance, Electron is a leading provider of wireless charging solutions for electric vehicles, enabling charging while driving or stationary.By integrating renewable energy sources and wireless charging capabilities, such portable EV chargers can significantly enhance the convenience and accessibility of electric vehicle charging, thereby encouraging more widespread adoption of EVs.

II. Literature Survey

1. Fareq, M. Fitra (2014) highlighted the fundamental concepts of wireless EV charging, emphasizing its potential to replace traditional wired systems.

2. p. Sri Haritha1 ,g. Srinivasa Rao, g. Jaya Sravani,
g. Lahari, g. Pavani, p. Naveena (2023) presented a solar-powered wireless charging system, discussing its practical implementation and benefits in reducing carbon footprints.

3. o.p. Suresh, Salava v Satyanarayana , p Hema Bindu3, k Anand, n Srujith Kumar, v Sujith (2024) analyzed wireless charging via inductive coupling, demonstrating its feasibility in real-world applications through simulations.

4. Seyed Ali Kashani, Alireza Soleimani, Ali Khosravi, And Mojtaba Mirsalim (2023) reviewed the latest advancements in wireless EV charging, comparing different techniques such as inductive and resonant coupling, and highlighting efficiency improvements.

5. Nikhil Manjare, Ashutosh Mane, Swapnil Gaikwad, Vineeta Philip(2023) provided a detailed experimental study on wireless car charging using solar power, showing its efficiency and limitations in real-time usage.Prajakta Pawaral, Shweta Deokate, Archana Dighule, Rutuja Swami (2022) focused on the practical challenges of solar-based wireless EV

chargers, including energy conversion losses and implementation constraints.

6. Nivedita Muganur, Naveen Manawadi, Manohar Malagi, Manjunath Malagi, Sidramayya Matad (2023) introduced a wireless charging system using ESP32, which enables remote monitoring and control for better efficiency.

7. Asst. Prof. Triveni Palorkar, Ankita Tiwari, Karina Katre, Aditi Vishwakarma, Tanmay Nale (2024) discussed solar-powered wireless charging from a commercial perspective, highlighting its economic viability and potential for large-scale adoption.

8. Amar Kamble, Chetana Mithbavkar, Prerana Chavan, Tejas Patankar, Prof. Surendra Sutar (2024) explored the integration of solar panels with inductive charging, showcasing improved energy efficiency through better panel placement.

9. Bugatha Ram Vara Prasad, m. Geethanjali, m. Sonia, s. Ganeesh, p. Sai Krishna (2022) examined a solar wireless charging system in urban environments, addressing space constraints and proposing solutions for optimized charging stations.

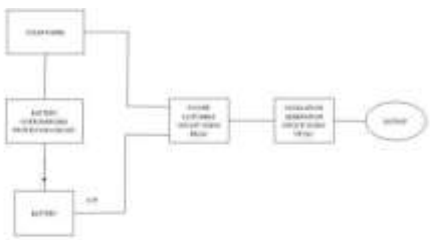
III. General Methodology

Solar power has gained significant popularity in recent years due to its numerous advantages and cost-effectiveness. As a result, more individuals and businesses are shifting to solar energy as an alternative to conventional energy sources.In this project, solar charging is implemented using solar panels, which convert sunlight into electrical energy (DC). This DC voltage is then stored in a battery bank. To prevent the reverse flow of energy from the battery to the solar panel, a reverse charging protection circuit is incorporated.The system uses a wireless power transfer (WPT) module to transmit electricity generated by the solar panel to the electric vehicle. This process is based on the principle of Electromagnetic Induction. The transfer coil is placed on the charging station, while the receiver coil is installed on the vehicle.To monitor the battery voltage, a voltage sensor is used. The microcontroller continuously measures the battery voltage and displays the readings on a 16x2 LCD screen. If the battery voltage drops below a predefined threshold, the system alerts the user by indicating a low battery status.Additionally, an L239D motor driver is used to control the movement of the vehicle's wheels, ensuring proper functionality of the system.This methodology enables efficient wireless charging of electric vehicles using renewable solar energy, reducing dependence on traditional charging infrastructure.

Component Required:-

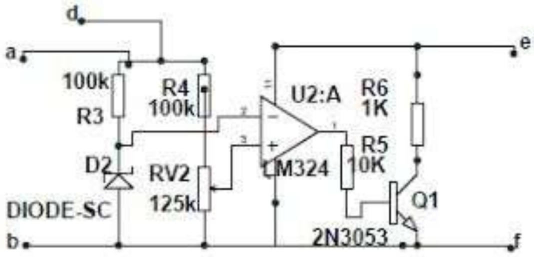
Input Secton (Transmitter) :

The input section is responsible for capturing solar energy, storing it, and converting it into wireless power.

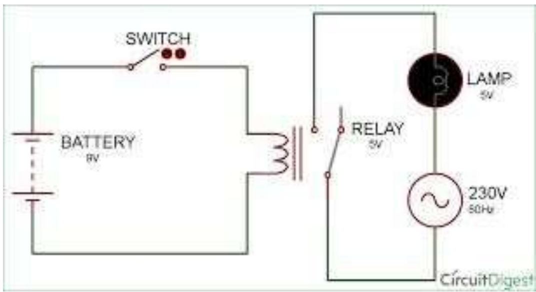


Solar Panel – The solar panel is the primary power source in this system. It converts sunlight into electrical energy through the photovoltaic effect. This energy is then stored in a battery for further use in wireless charging. The efficiency of the system depends largely on the quality and capacity of the solar panel used (4).

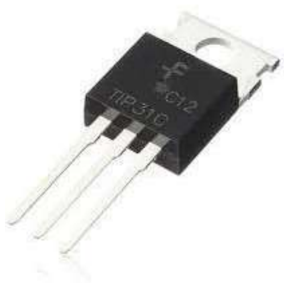
Battery and Overcharging Protection Circuit – The battery stores the energy generated by the solar panel and supplies it when required. Since overcharging can damage the battery, a battery overcharging protection circuit is used. This circuit ensures that the battery does not receive excess charge, preventing overheating and extending battery life.



Power Switching Circuit Using Relay – A relay- based power switching circuit controls the flow of electricity from the battery to different components of the system. The relay acts as an automatic switch, enabling or disabling power transfer based on the system's requirements. This helps in efficient energy management.



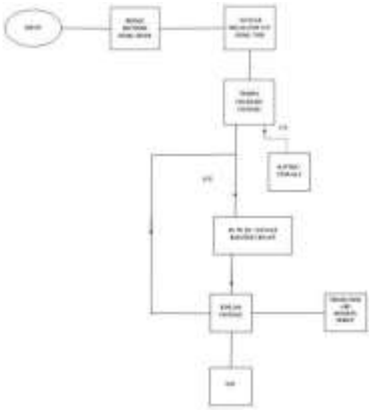
Oscillation Generation Circuit Using TIP31C Transistor – Wireless power transfer relies on alternating current (AC) to generate an oscillating magnetic field. The TIP31C transistor is used in an oscillation generation circuit, which converts direct current (DC) from the battery into AC. This AC current is then passed through the transmitting coil to create a magnetic field for wireless charging.



Transmitting Coil – This is a copper coil that generates an electromagnetic field when AC current flows through it. This field is responsible for wirelessly transferring energy to the receiver coil in the EV.

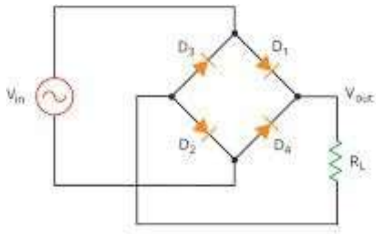
Output Section(Receiver):

The receiver section is responsible for capturing the transmitted energy, converting it into usable DC power, and monitoring the charging process. It includes:

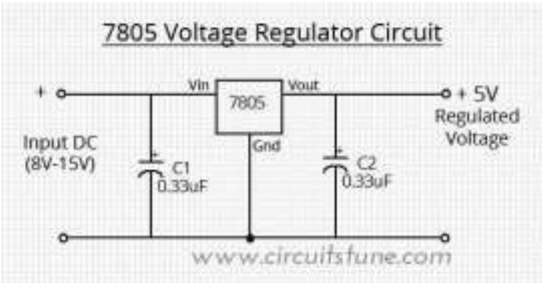


Receiver Coil – The receiver copper coil is placed on the EV and is responsible for capturing the electromagnetic energy from the transmitting coil. This energy is then converted back into electrical energy for charging the EV battery.

Bridge Rectifier Using Diodes – Since the received energy is in AC form, a bridge rectifier made of diodes is used to convert it into DC voltage. This conversion is necessary because the EV battery and other electronic components operate on DC power.



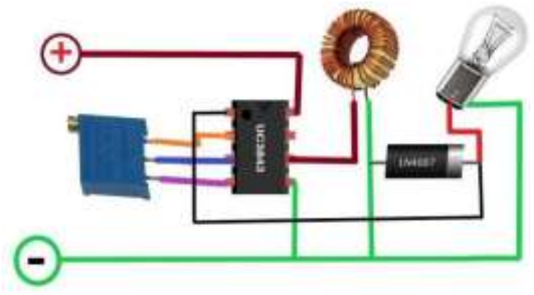
Voltage Regulator Circuit Using 7805 – The 7805 voltage regulator is used to maintain a stable 5V DC output. Many electronic components, such as the ESP8266 module and LCD screen, require a precise voltage supply, which this circuit provides by regulating fluctuations.



TP4056 Charging Module – This module is used for safe and efficient charging of lithium-ion batteries. It provides protection against overcharging, short circuits, and excess current flow, ensuring a longer battery lifespan.

LCD Screen (16x2) – The 16x2 LCD display is used to show real-time information such as battery voltage, charging status, and power levels. This helps users monitor the system's performance efficiently.

DC-DC Voltage Booster Circuit – The output voltage from the receiver coil may not always be sufficient to charge the EV battery. A DC-DC booster circuit is used to increase the voltage to the required level, ensuring efficient power delivery to the EV.

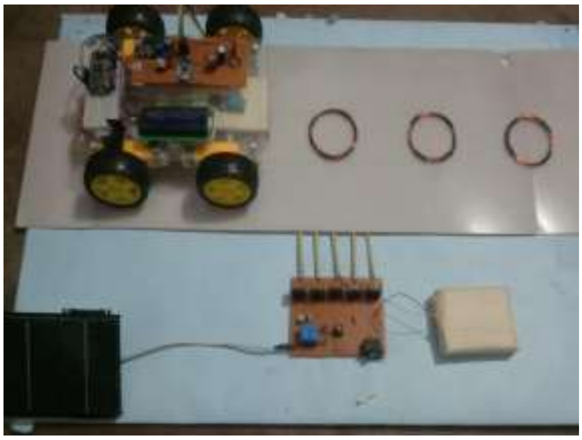


ESP8266 Module – The ESP8266 is a WiFi-enabled micro controller used for monitoring and controlling the charging process remotely. It allows data transmission to a cloud server or a mobile app, enabling users to check charging status and performance.

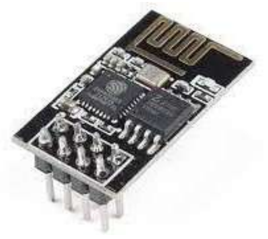
IV. Result & Discussion

The results of the Solar Powered Wireless Electric Vehicle (EV) Charging System demonstrate significant advancements in sustainable transportation infrastructure and energy management. Through rigorous testing and validation, the system has achieved remarkable outcomes in terms of efficiency, reliability, and environmental impact. One of the key findings is the system's ability to harness solar energy effectively, with solar panels demonstrating high energy capture rates and consistent power output. This solar energy is seamlessly integrated into the charging infrastructure, providing a renewable and eco-friendly source of power for electric vehicles.

Hardware Output



LCD Display show temperature humidity and voltage.



V. Conclusion

The development of a solar- powered wireless charging system for electric vehicles (EVs) represents a significant advancement toward sustainable transportation solutions. By integrating solar energy with wireless charging technology, this system offers a convenient and eco-friendly alternative to traditional charging methods. The use of solar panels harnesses renewable energy, reducing reliance on fossil fuels and minimizing carbon emissions. Wireless charging eliminates the need for physical connectors, enhancing user convenience and safety. This innovative approach not only addresses the growing demand for efficient EV charging infrastructure but also contributes to a cleaner and more sustainable future for transportation.

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