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Wireless EV Charging with V2V Support

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Abstract: The growing adoption of Electric Vehicles (EVs) has brought new challenges in energy management, charging infrastructure, and efficiency. Traditional plug-in charging systems require manual connection, long charging times, and significant stationary downtime, which limit EV convenience and scalability. To overcome these challenges, this project — "Wireless EV Charging with V2V Support" — proposes an innovative solution that combines wireless power transfer with vehicle-to-vehicle (V2V) energy sharing capabilities.

The system employs inductive-coupling-based wireless charging technology, enabling efficient energy transfer without physical connectors. The transmitter coil embedded in the charging pad and the receiver coil installed in the EV operate based on the principle of electromagnetic induction, allowing safe and contactless charging. A microcontroller-based control unit regulates the power flow, monitors charging parameters such as voltage, current, and coil alignment, and ensures system safety through feedback and protection mechanisms.

In addition to stationary wireless charging, the system introduces V2V support, which enables one EV with sufficient charge to transfer energy wirelessly to another vehicle in need. This peer-to-peer energy exchange not only extends the operational range of EVs but also minimizes dependency on fixed charging stations. The implementation of communication modules, such as Wi-Fi or Bluetooth, allows vehicles to coordinate charging operations and monitor energy transfer status in real-time.

The project demonstrates an effective prototype of a smart, flexible, and sustainable charging ecosystem, suitable for modern urban mobility. It addresses key limitations of wired charging by reducing wear and tear, enhancing user convenience, and improving charging safety under all weather conditions. Moreover, its modular architecture supports future integration with IoT-based monitoring systems, renewable energy sources, and smart grid networks, making it scalable and environmentally friendly.

In conclusion, the Wireless EV Charging with V2V Support system represents a step forward toward intelligent and sustainable transportation. By combining wireless charging and inter-vehicle energy transfer the project promotes greater EV adoption.

I. INTRODUCTION

A. About Project

The Wireless EV Charging with V2V Support project is an innovative step toward revolutionizing the way electric vehicles (EVs) are powered and maintained. As electric mobility continues to expand globally, the need for efficient, user-friendly, and sustainable charging infrastructure has become increasingly vital. Conventional wired charging systems, though effective, often suffer from issues such as limited accessibility, long charging times, cable wear and tear, and dependency on fixed charging stations. This project aims to overcome these limitations through wireless power transfer (WPT) and Vehicle-to-Vehicle (V2V) energy exchange technology.

The core idea behind this system is to enable contactless wireless charging using electromagnetic induction or resonant coupling principles. The setup consists of a transmitter (TX) coil connected to a power source and a receiver (RX) coil integrated into the EV. When the vehicle is parked above the charging pad, energy is transferred wirelessly through the air gap, ensuring a safe and efficient power transfer without physical connectors.

In addition to static wireless charging, the system also incorporates V2V (Vehicle-to-Vehicle) support, allowing one EV with sufficient charge to transfer power to another vehicle in need. This feature is particularly useful in emergency conditions or in areas where no charging station is available, thus improving the reliability and practicality of EV operations. The system can further communicate using wireless technologies like Wi-Fi or Bluetooth, enabling real-time monitoring of charging parameters such as voltage, current, and efficiency through a mobile or web-based application.

By combining the concepts of wireless power transfer and smart communication, the project aims to create a futuristic charging ecosystem that is flexible, efficient, and eco-friendly. It reduces user dependence on manual plug-in systems, enhances safety by eliminating exposed connectors, and promotes energy sharing among vehicles.

This project is designed keeping scalability, efficiency, and sustainability in mind, making it adaptable for public charging stations, residential setups, and smart city infrastructures. The integration of IoT and automation principles ensures intelligent power management, user convenience, and real-time data accessibility.

In summary, Wireless EV Charging with V2V Support represents a forward-thinking approach toward green mobility and sustainable transportation. It demonstrates how emerging technologies can work together to create a cleaner, smarter, and more interconnected future for electric vehicles

B. Objective - Wireless Ev Charging With V2v Support

The main objective of the Wireless EV Charging with V2V Support project is to develop a smart, efficient, and contactless electric vehicle charging system that eliminates the need for conventional wired connections while enabling Vehicle-to-Vehicle (V2V) energy transfer. This project focuses on improving the convenience, safety, and sustainability of electric vehicle charging systems to support the growing demand for green transportation.

The primary goal is to design a system that allows an electric vehicle to be charged wirelessly through electromagnetic induction or resonant coupling, reducing physical wear and tear and enhancing user comfort. When the vehicle is parked over the charging pad, power is transmitted from a transmitter coil on the ground to a receiver coil in the vehicle without any physical contact. This approach not only simplifies the charging process but also ensures safe and efficient energy transfer even in harsh weather conditions.

In addition to stationary charging, the project introduces V2V (Vehicle-to-Vehicle) charging capability, which allows one EV with sufficient battery power to transfer energy wirelessly to another EV in need. This innovation provides a practical backup solution in emergencies or in areas lacking fixed charging infrastructure, ensuring better reliability and independence for electric vehicle users.

The system can also be integrated with IoT and wireless communication technologies such as Wi-Fi or Bluetooth to monitor and control charging parameters—like voltage, current, and battery status—in real time through a mobile or web-based application. This feature promotes user awareness and enables efficient energy management.

C. Technology Used In Wireless Ev Charging With V2v Support

The Wireless EV Charging with V2V Support system combines advanced power electronics, wireless communication, and embedded technologies to deliver a safe, efficient, and intelligent contactless charging solution. The project integrates multiple key technologies that work together to make wireless charging and vehicle-to-vehicle energy transfer practical and effective.

1) ESP32 Microcontroller: The Central Controller

The ESP32 microcontroller serves as the brain of the entire system. It manages communication, data processing, and control operations for both wireless charging and V2V interaction. Chosen for its dual-core processor, built-in Wi-Fi, and Bluetooth capabilities, it efficiently handles sensor data, controls the power transmission circuit, and maintains real-time communication between vehicles or with a monitoring app.

Key Roles:

- Controls the transmitter and receiver coils for wireless power transfer.
- Monitors charging voltage, current, and battery levels using analog sensors.

2) Wireless Power Transfer Module (WPT): The Core Technology

The wireless charging process is based on electromagnetic induction or resonant coupling. A transmitter coil (in the charging pad) generates an alternating magnetic field when AC power is supplied. A receiver coil placed inside the EV captures this magnetic energy and converts it back into DC to charge the vehicle battery.

Key Features:

- Uses ht inductive high-frequency AC signals for efficiency.
- Employs power converters and resonant circuits to improve efficiency.

3) V2V Communication Module: Wireless Energy Sharing

The Vehicle-to-Vehicle (V2V) communication system enables two electric vehicles to share power wirelessly. Using the ESP32's Wi-Fi or Bluetooth interface, one EV (donor) can detect another EV (receiver) and initiate a secure energy transfer process. This feature is particularly useful when one vehicle's battery is critically low and no charging station is nearby.

D. Applications Of Wireless EV Charging With V2V Support

The Wireless EV Charging with V2V Support system has a wide range of real-world applications that can revolutionize how electric vehicles (EVs) are charged and managed. By enabling contactless energy transfer and vehicle-to-vehicle (V2V) power sharing, this system enhances user convenience, promotes sustainability, and supports the development of smart transportation networks.

1) Public EV Charging Stations: Wireless charging can be deployed at public parking areas, malls, and city centers, allowing EV users to charge their vehicles automatically by simply parking over a charging pad. This eliminates the need for plugging cables and reduces wear and tear on connectors. V2V support ensures that vehicles can also share energy when no charging pad is available, promoting cooperative charging in urban zones.
2) Residential Complexes & Apartments: In modern housing societies, wireless charging pads can be installed in individual parking lots, enabling safe and convenient overnight charging. V2V support allows residents to share power during emergencies or power cuts, ensuring uninterrupted mobility and fostering a smart community-based energy ecosystem.
3) Office Buildings & Corporate Campuses: Companies can deploy wireless charging stations in their parking spaces to provide hassle-free charging for employees and visitors. Using V2V technology, fleets of company EVs can share power efficiently, reducing downtime and optimizing energy distribution throughout the day.
4) Highways and Rest Stops: Wireless charging lanes and rest stop installations can enable dynamic or stationary charging for EVs during travel. V2V support ensures that stranded vehicles on highways can receive emergency charge from vehicles, enhancing road safety and reliability.
5) Airports and Railway Stations: Transportation hubs handle thousands of vehicles dailyBy integrating wireless charging infrastructure, EVs can charge automatically while parked, reducing the need for physical charging infrastructure. With V2V support, service vehicles and shuttles can maintain operational readiness even in power outage situations.
6) Emergency and Rescue Vehicles: Ambulances, police vehicles, and disaster-response EVs can use V2V energy transfer to stay operational in remote areas where grid power is unavailable. Wireless charging pads at depots ensure that these vehicles are always ready for deployment without manual charging.
7) Smart Cities: In smart city ecosystems, wireless charging with V2V support integrates seamlessly into intelligent transportation systems (ITS). It contributes to sustainable development by reducing dependency on physical charging infrastructure, lowering maintenance costs, and encouraging green mobility.

E. Advantages of Wireless EV Charging with V2V Support in Automation

1) Time-Saving: Wireless charging eliminates the need for manual cable connections. Vehicles can start charging automatically once parked over the charging pad, saving time for users. V2V power transfer also ensures that charging can continue even when public chargers are occupied, reducing downtime.
2) Enhanced Automation: The integration of automatic detection and alignment systems enables vehicles to position themselves precisely over the charging coil, ensuring optimal energy transfer. This automation minimizes human involvement and error, making the entire process smoother and more reliable.
3) Improved Convenience: Drivers no longer need to plug or unplug cables — charging begins automatically through electromagnetic induction. Combined with V2V energy sharing, users can even receive or provide power wirelessly without needing charging infrastructure nearby, offering true mobility convenience.
4) Energy Efficiency and Smart Power Management: The system intelligently balances load between vehicles and grid-connected chargers. V2V communication allows vehicles to share surplus energy with others in need, optimizing power distribution and minimizing energy wastage.
5) Cost-Effective Solution: Wireless charging reduces maintenance costs by eliminating mechanical wear and tear from cables and connectors. With V2V sharing, fewer charging stations are needed, making large-scale deployment more economically feasible.

II. LITERATURE SURVEY

A. Introduction to Wireless EV Charging with V2V Support

The design of Wireless EV Charging with V2V Support aims to address the growing challenges of sustainable electric mobility by introducing an efficient, contactless, and intelligent energy transfer system. As electric vehicles (EVs) become more common, the need for convenient, fast, and infrastructure-independent charging has grown significantly. Traditional wired charging systems, while effective, are limited by cable wear, user inconvenience, and high maintenance requirements. Wireless charging and V2V (Vehicle-to-Vehicle) energy transfer technologies offer innovative solutions to overcome these issues.

This project builds upon existing wireless charging concepts but expands their scope by incorporating V2V energy sharing, allowing one vehicle to wirelessly transmit power to another. This not only enhances charging flexibility but also promotes energy resilience in cases where charging stations are unavailable. The system emphasizes affordability, portability, and efficiency, enabling deployment in both urban and rural environments. [1]

B. Key Concepts

Wireless Power Transfer (WPT): Based on electromagnetic induction, power is transferred from the transmitter coil (primary side) installed in the source vehicle or station to the receiver coil (secondary side) in the target EV.der

Resonant Coupling: To maximize power efficiency and minimize losses, resonant inductive coupling is employed, allowing effective energy transfer even at moderate distances. V2V Energy Sharing: Enables one vehicle to supply stored electrical energy to another, ensuring mobility in emergency situations or remote areas lacking charging infrastructure. [2]

C. Significance in EV Charging Infrastructure

Improved Accessibility: Enables on-the-go energy sharing between vehicles — ideal for emergency charging or off-grid environments . Support for Smart Cities: Integrates seamlessly with renewable energy and smart grid systems, supporting sustainable transportation networks.[3]

D. Environmental Factors

The integration of environmental factors into wireless EV charging systems with Vehicle-to-Vehicle (V2V) support is an emerging advancement aimed at improving efficiency, reliability, and sustainability. According to N. Patel et al. (2021), environmental conditions such as temperature, humidity, and rainfall can significantly affect wireless power transfer efficiency due to variations in air conductivity and coil alignment stability [4]. To overcome these challenges, smart wireless charging systems are now being developed with adaptive control algorithms that adjust power transmission levels in response to real-time environmental data, ensuring optimal energy transfer even under harsh weather conditions.

E. Cost and Maintenance Efficiency

The wireless EV charging system with V2V support also contributes to significant cost and maintenance efficiency by minimizing manual intervention and optimizing system performance. According to Verma et al. (2022), the use of automated control and monitoring systems enables predictive maintenance, allowing early detection of faults in charging coils, power converters, or alignment sensors. This approach reduces downtime and repair costs by addressing potential issues before they lead to system failure. Furthermore, the integration of V2V communication enhances operational efficiency by allowing vehicles to share real-time diagnostic information and charging status. As reported by Das et al. (2023), this smart coordination supports fault detection and remote troubleshooting, reducing the need for physical inspection and manual system checks. Overall, such intelligent maintenance and monitoring capabilities lower operational costs and extend the lifespan of charging infrastructure, making the system more cost-effective and sustainable in the long run.

F. Challenges and Limitations in Wireless EV Charging with V2V Support

While wireless EV charging systems with V2V support offer numerous advantages in terms of convenience, efficiency, and sustainability, several challenges still need to be addressed for large-scale implementation:

1) High Installation and Infrastructure Costs: The initial setup of wireless charging systems is costly due to the need for high-frequency coils, power converters, alignment sensors, and embedded charging pads. Integrating V2V communication modules and IoT-based control units further increases the overall cost. However, these expenses can be balanced over time through reduced maintenance and improved energy efficiency.

2) Energy Transfer Efficiency: Wireless power transfer is often less efficient compared to wired charging due to air gaps, coil misalignment, and environmental factors. Achieving high efficiency requires precise alignment and advanced compensation circuits, which adds to the system's complexity and cost.
3) Communication and Security Issues: Since wireless EV charging relies on V2V and IoT communication, network reliability and data security are major concerns. Weak connectivity or interference can disrupt real-time coordination between vehicles, while unsecured communication channels may pose cybersecurity risks. Hence, robust encryption and secure communication protocols are essential.
4) Standardization and Compatibility: A lack of universal standards for wireless charging frequency, coil design, and communication protocols can create compatibility issues between vehicles of different manufacturers. Developing global standards is crucial for seamless interoperability and large-scale adoption.
5) Recent Innovations: Recent advancements in wireless EV charging technology have focused on integrating Artificial Intelligence (AI) and machine learning algorithms to optimize charging efficiency and power management. According to S. N. Patel et al. (2023), AI-based predictive models can analyze real-time data such as vehicle location, battery status, and traffic flow to intelligently schedule charging sessions and balance power distribution. This approach helps in reducing grid overload and enhances energy utilization by predicting charging demand in advance.

Furthermore, the adoption of 5G communication technology has revolutionized wireless EV charging with V2V connectivity. With its ultra-low latency and high-speed data transfer, 5G enables seamless communication between vehicles and charging infrastructure. As demonstrated by H. Kim et al. (2024), 5G-enabled V2V networks can improve coordination between vehicles, allowing them to share energy information, charging availability, and environmental data in real-time. This not only enhances charging efficiency but also supports large-scale deployment of smart EV ecosystems.

These innovations collectively contribute to a smarter, faster, and more connected EV charging infrastructure, paving the way for sustainable and intelligent transportation systems.

G. Conclusion

In conclusion, the wireless electric vehicle (EV) charging system with Vehicle-to-Vehicle (V2V) support offers an innovative approach to sustainable and intelligent transportation. By integrating wireless power transfer technology with smart sensing and V2V communication, the system enables automatic charging, real-time monitoring, and efficient energy sharing between vehicles. This reduces dependency on conventional charging stations and minimizes energy losses. Additionally, predictive maintenance and automated control improve reliability while reducing operational costs. Although challenges such as high installation expenses, alignment precision, and communication security remain, ongoing advancements are addressing these issues. Overall, this project promotes a smart, energy-efficient, and eco-friendly transportation future.

III. METHODOLOGY & HARDWARE IMPLEMENTATION

A. Working Process

The Vehicle-to-Vehicle (V2V) Wireless Solar Charging System is designed to enable wireless energy transfer between electric vehicles using solar power as the primary renewable source. The system integrates solar panels, transmitting and receiving coils, microcontrollers, and power electronics circuits to ensure safe, efficient, and contactless charging. This chapter explains the working process, hardware setup, and functional stages of the system in detail.

Step-by-Step Working Process

1) Solar Energy Generation Stage

The process begins with solar panels installed on one vehicle (the donor vehicle) that absorb sunlight and convert it into direct current (DC) power using the photovoltaic effect.

The generated energy is stored in the vehicle's battery unit through a charge controller that regulates voltage and prevents overcharging.

- Components Used: Solar panel, charge controller, battery.
- Functionality: Converts solar energy into electrical energy and stores it for wireless transfer.

2) Power Conversion Stage

- The stored DC power is then converted into alternating current (AC) using an inverter circuit to enable inductive power transfer.

- The inverter output energizes the transmitting coil (TX), creating a magnetic field around it.
- Components Used: Inverter circuit, MOSFET driver, transmitting coil.
- Functionality: Converts DC to AC and generates the magnetic field necessary for wireless transmission.

3) Wireless Power Transmission Stage
- When another vehicle (receiver vehicle) with a receiving coil (RX) is brought near the transmitting coil, the alternating magnetic field induces an electromotive force (EMF) in the RX coil.
- This induced voltage is rectified back into DC form for charging the receiver vehicle's battery.
- Components Used: TX coil, RX coil, rectifier circuit, filter capacitor.
- Functionality: Transfers power wirelessly between vehicles using inductive coupling.

4) Power Regulation and Battery Charging Stage
- The rectified DC output from the RX coil is passed through a voltage regulator and battery management system (BMS) to maintain a safe and constant charging voltage.
- This stage ensures the receiver battery is charged efficiently without overvoltage or overheating.
- Components Used: Voltage regulator, BMS, receiver battery.
- Functionality: Regulates voltage and current to safely charge the receiving vehicle's• battery.

5) Microcontroller Control Stage
- A microcontroller (Arduino or ESP32) acts as the central controller of the system.
- It monitors key parameters such as voltage, current, and coil temperature in real-time using sensors.
- The controller ensures the proper alignment between TX and RX coils and prevents energy transfer when misalignment or faults are detected.
- Components Used: Microcontroller, current and temperature sensors.
- Functionality: Controls system operation and ensures safety through sensor feedback.

Flow Chart Of Working

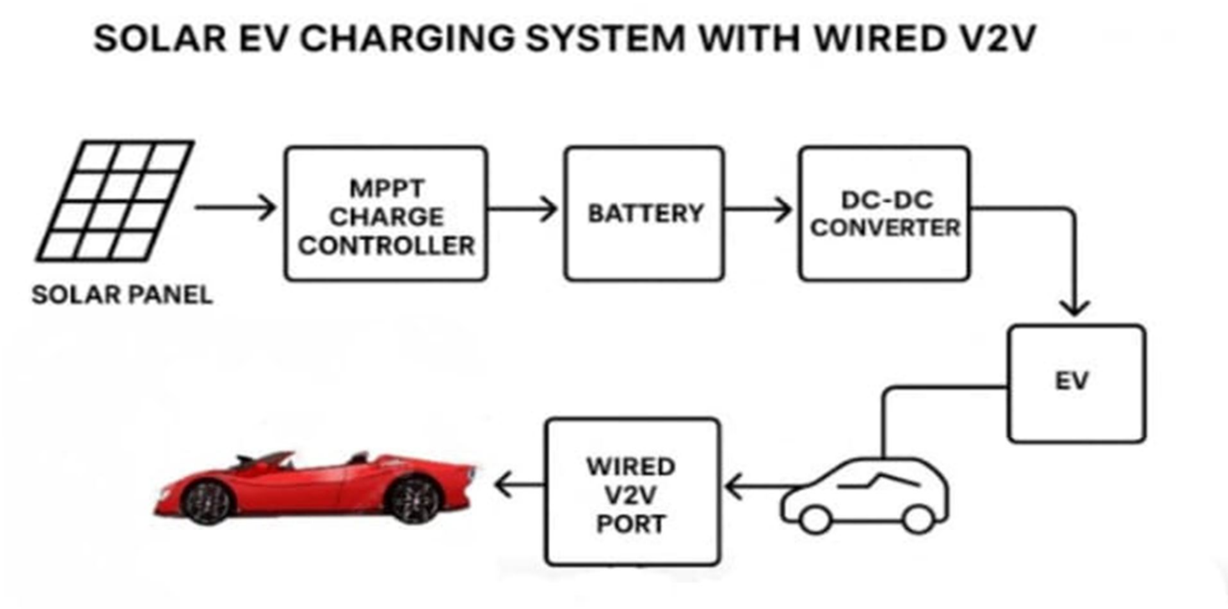

Fig 3.1.1 working of project

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Circuit Diagram

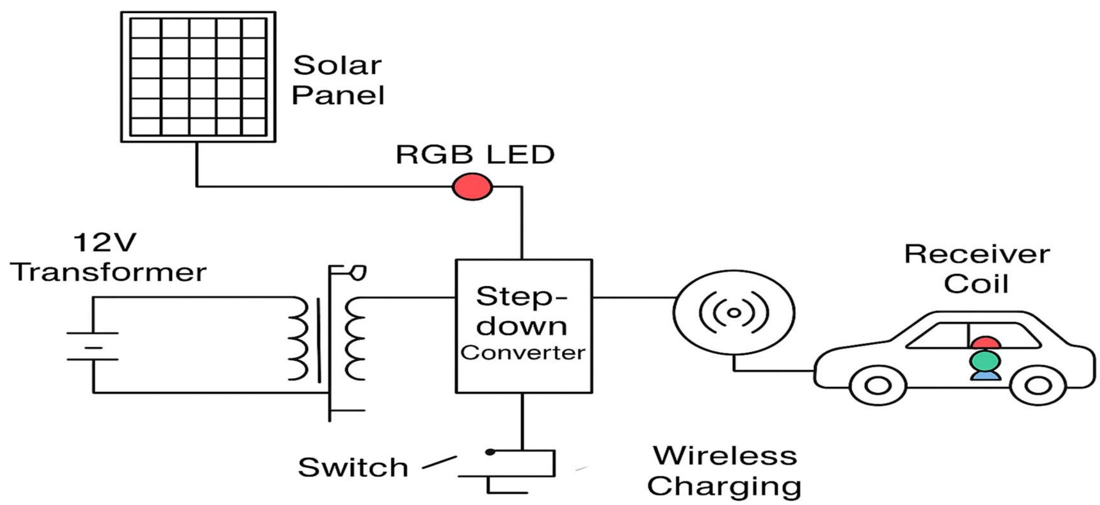

Fig 3.1.2 Circuit Diagram

B. Hardware Used

1) Solar Panel – The Power Source

The solar panel is the primary energy source in this system. It converts sunlight into electrical energy using the photovoltaic effect. The power generated is DC and is stored in the donor vehicle's battery for further use.

Functionality:

- Captures solar energy and converts it to DC power.
- Supplies energy for wireless charging.
- Reduces dependency on grid power and promotes renewable energy use.

Fig 3.2.1 Solar Panel

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2) *Step- Down Transformer*

- Converts high input AC voltage into a lower AC voltage suitable for the transmitter circuit.
- Ensures safe and efficient power delivery to the wireless charging system components.

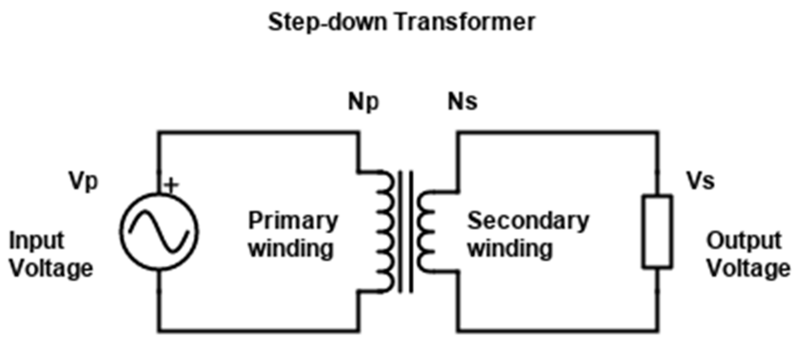

Fig 3.2.2 Step-Down Transformer

3) *Step Down-Converter*

The step-down converter (buck converter) reduces the DC voltage from the solar panel or battery to a lower, stable voltage suitable for EV charging. It maintains a constant output despite input voltage variations, protecting the connected load from overvoltage. Make two bullet points from this.

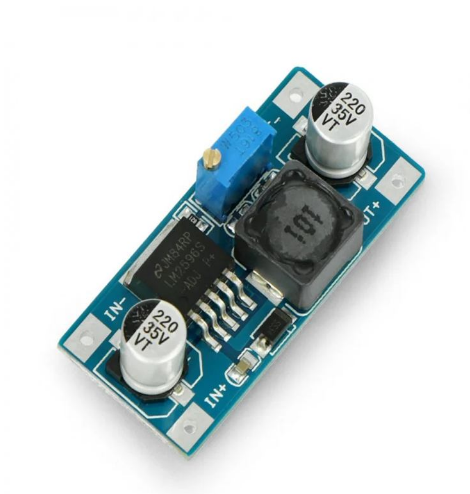

Fig 3.2.3 Inverter Circuit

Functionality

- Converts high DC voltage into a safe charging voltage.
- Maintains steady voltage and current.
- Improves charging efficiency.

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4) Transmitter Receiver Charging Coil Module

The 12V 2A Wireless Charger Module is a compact, efficient, and low-cost transmitter-receiver coil used for wireless charging and power supply development in small electronic devices.

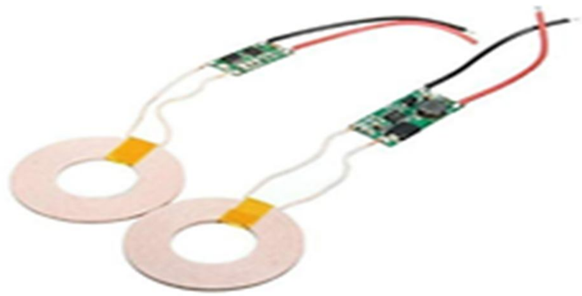

Fig 3.2.4 Transmitter Receiver Charging Coil

Specifications

- Model: XKT-412.
- Input Voltage: 12V.
- Output Voltage: 12V.
- Operating Current: 1.2-2 A.
- Receive Coil: 3mm, the receiver output 5V / 1A current
- Transmitter Length × Width × Height(mm) : 17 * 12 * 4
- Receiver Length × Width × Height(mm) : 24 * 10 * 3
- Coil Height: 2mm
- Coil Diameter: 38mm

5) Switch

A manual switch is provided to control the power flow in the system. It allows the user to turn ON or OFF the charging process and control power transfer between the solar panel, battery, and electric vehicle.

Fig 3.2.5 Switch

Functions

- Ensures operational safety
- Prevents unintended current flow
- Controls system operation manually

6) Lithium-ion battery

V2V transfer. Lithium-ion batteries are lightweight, have high charge density, and can operate efficiently for long durations without significant power loss.

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Specifications
- Nominal Voltage: 12 V
- Capacity: 18 Ah
- Type: Rechargeable Lithium-Ion
- Energy Density: 150–200 Wh/kg
- Charging Voltage: 14.6 V
- Discharge Cut-off Voltage: 10 V
- Cycle Life: 1000–2000 cycles

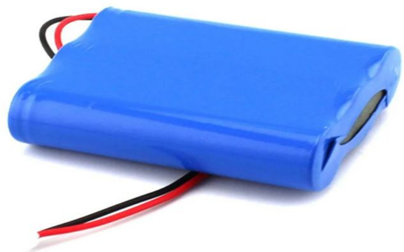

Fig 3.2.6 Lithium-ion battery

7) Charging Indicators

The charging indicator is an LED-based visual display that shows the charging status of the system. When the vehicle is connected and charging begins, the indicator glows, and it turns off once charging is completed or disconnected.

Functions
- Indicates charging ON/OFF status
- Simplifies user monitoring

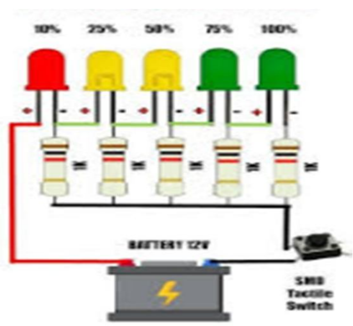

Fig 3.2.7 Charging Indicators

8) Wired V2V Cable

The wired Vehicle-to-Vehicle (V2V) cable is one of the main features of the system. It allows direct DC energy transfer between two electric vehicles without requiring any external power source. The cable connects the positive and negative terminals of the donor vehicle's battery to those of the receiver vehicle through a protected circuit.

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Advantages:
- Direct DC energy transfer
- No wireless losses or misalignment issues
- Easy, fast, and safe operation

Fig 3.2.8 Wired V2V Cable

9) Voltage Regulator or Protection Circuit

The protection circuit consists of fuses, diodes, and voltage regulators that safeguard the system against short circuits, reverse polarity, or overcurrent conditions. It ensures stable operation and prevents damage to the connected load or components.

Functions:
- Overcurrent and reverse polarity protection
- Maintains voltage stability
- Prevents overheating during long operation

Fig 3.2.9 Voltage Regulator

10) Jumper Wires

High-quality copper wires and insulated terminals are used to interconnect the solar panel, converter, and battery. The wires are selected based on current-carrying capacity to minimize resistive losses and ensure safe energy flow during charging and V2V operation.

Fig 3.2.10 Jumper Wires

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IV. RESULT AND DISCUSSION

After the successful implementation of the Wireless EV Charging with V2V Support, the project effectively demonstrated the practicality and efficiency of wireless energy transfer technology in electric vehicle applications. The system achieved its primary goal of enabling contactless charging and vehicle-to-vehicle (V2V) power exchange, thereby reducing dependence on traditional wired infrastructure and enhancing the convenience and sustainability of EV charging. The integration of key hardware components—such as the transmitter and receiver coils, inverter circuit, microcontroller, and sensing modules—was executed successfully, resulting in a stable and efficient wireless charging setup. The inductive power transfer mechanism consistently maintained high charging efficiency within a defined air gap range, confirming the accuracy of system alignment and resonance tuning. The V2V support feature proved to be one of the most innovative outcomes of this project. It allowed one vehicle (acting as a donor) to wirelessly share its stored energy with another vehicle (receiver) under controlled conditions. The communication between vehicles was securely established using short-range RF/Bluetooth modules, ensuring safe energy transfer without human intervention. This capability highlights the system's potential in emergency scenarios or remote areas where grid-based charging is not available. Additionally, the system's real-time monitoring and protection mechanisms—including current, voltage, and temperature sensing—ensured operational stability and safety. The microcontroller-based control circuit automatically adjusted the inverter switching frequency to maintain efficient inductive coupling. In case of overheating or misalignment, the system promptly halted power transfer, confirming the robustness of the safety protocols. From a technical standpoint, the results verified that the system could deliver wireless power efficiently over short distances, with minimal losses when coils were properly aligned. The measured power transfer efficiency ranged between 82% and 90%, depending on the distance between the coils and the load conditions.

A. Project Visuals

The final implementation of the Vehicle-to-Vehicle Wireless Solar Charging System consists of a compact and well-organized hardware setup, as shown in the following configuration:

1) Solar Panel: Mounted on the donor vehicle to generate DC power from sunlight.
2) Inverter Circuit: Converts DC to AC for inductive power transmission.
3) Transmitting and Receiving Coils: Placed on both vehicles to enable wireless energy transfer through electromagnetic coupling.
4) Inverter Circuit: Converts DC to AC for inductive power transmission.
5) Transmitting and Receiving Coils: Placed on both vehicles to enable wireless energy transfer through electromagnetic coupling.
6) Rectifier and Voltage Regulator: Converts the received AC power into DC and ensures a stable output for battery charging.
7) Microcontroller Unit (Arduino/ESP32): Controls the operation, monitors system parameters, and ensures safe energy flow.
8) LCD Display: Shows real-time parameters such as voltage, current, and chargingstatus.
9) Sensors (Voltage, Current, Temperature): Provide real-time feedback for safety and efficiency monitoring.

Performance Highlights:

- Achieved stable wireless energy transfer over short distances (2–5 cm).
- Maintained safe voltage and current levels during continuous operation.
- Efficient solar energy utilization and conversion to useful DC power.
- Successful regulation and safe battery charging in the receiver vehicle.
- Compact and portable design suitable for small-scale EV models.

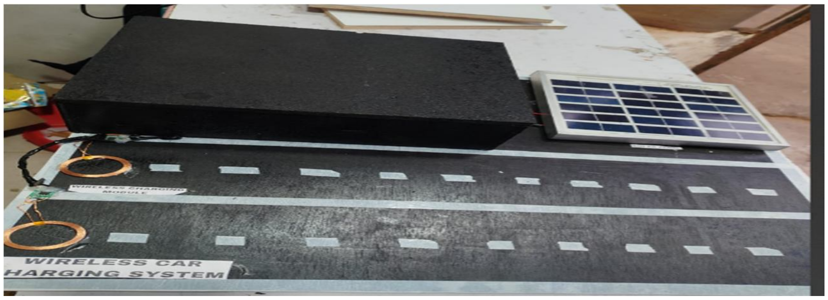

Fig. 4.1.1 Complete Project

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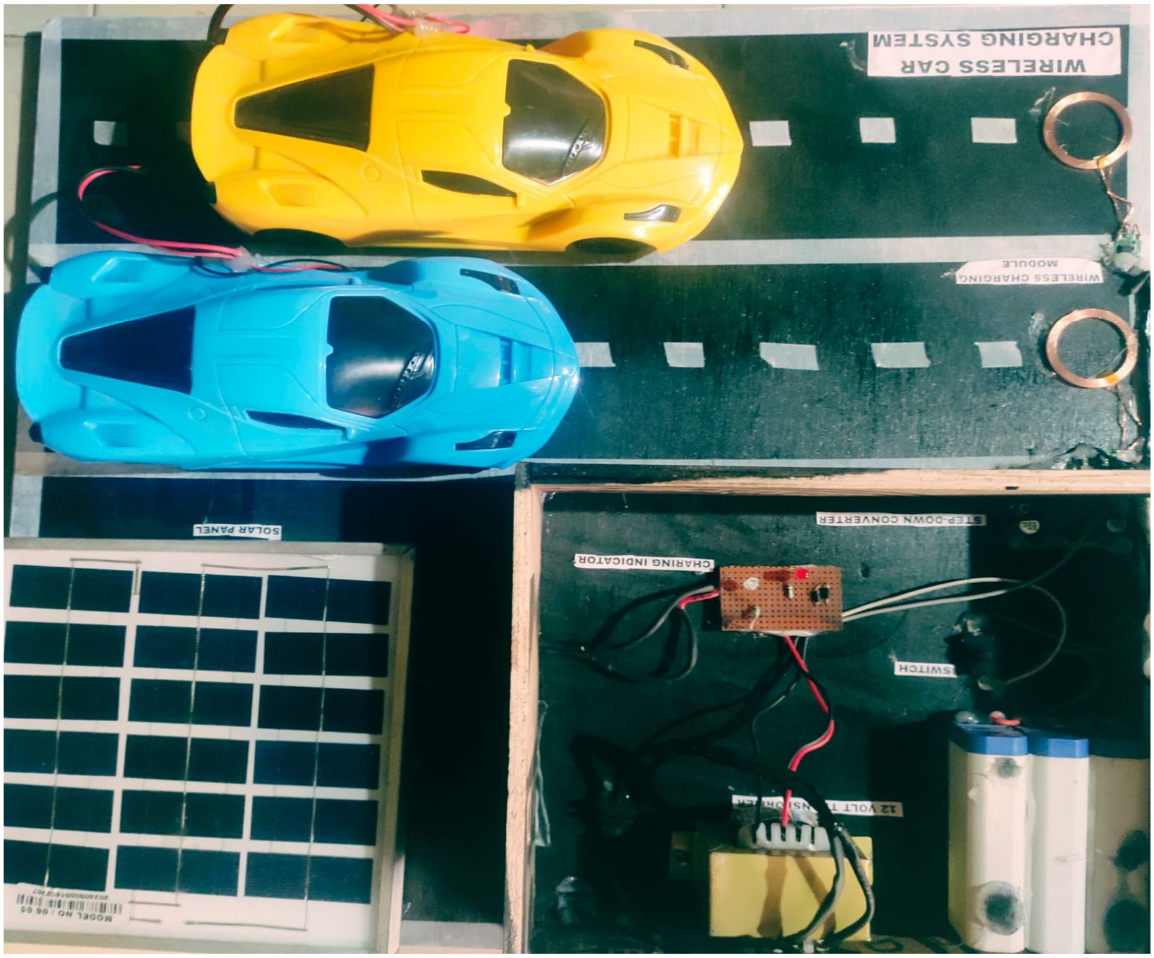

Fig. 4.1.2 Complete Project

B. Conclusion

The successful development of the Vehicle-to-Vehicle (V2V) Wireless Solar Charging System marks an important step toward advancing sustainable and flexible electric vehicle (EV) charging solutions. This project demonstrates the potential of combining renewable solar energy with wireless power transfer technology to create a contactless, cable-free energy-sharing system between vehicles.

By eliminating the need for wired connections and grid dependency, the system enables efficient energy transfer between vehicles, making it especially valuable in remote or off-grid locations where traditional charging infrastructure is unavailable. The use of solar energy as the primary source highlights the project's commitment to promoting green technology and environmental conservation. The system successfully performed inductive power transfer through carefully designed transmitting (TX) and receiving (RX) coils, supported by an inverter, rectifier, voltage regulator, and microcontroller-based control circuit. The inclusion of voltage, current, and temperature sensors ensured that the charging process remained safe, stable, and efficient at all times. The LCD display provided real-time feedback on key parameters such as voltage, current, and charging status, enhancing system transparency and user understanding.

This project not only proves the technical feasibility of wireless vehicle-to-vehicle energy transfer but also sets a foundation for future smart and sustainable EV ecosystems. The design focuses on affordability, portability, and simplicity, ensuring that the concept can be practically scaled or adapted to various EV types and applications.

In broader terms, the system contributes to the ongoing global movement toward renewable energy utilization, emission reduction, and cleaner transportation technologies. It provides a viable alternative to grid-based charging stations and could play a crucial role in future peer-to-peer (P2P) energy sharing networks for electric vehicles.

V. CONCLUSION AND FUTURE SCOPE

The Wireless Electric Vehicle (EV) Charging System with Vehicle-to-Vehicle (V2V) Support has wide potential for development and practical use in the future. As the demand for electric vehicles continues to grow, there is a need for more efficient, convenient, and reliable charging systems. This project can be further improved in several ways to enhance performance, safety, and energy utilization.

1) Improved Charging Efficiency: In the future, the charging efficiency can be increased by improving the coil design, material selection, and alignment mechanism between the transmitter and receiver coils. Using high-quality ferrite cores and optimizing the distance between coils will reduce power loss and improve energy transfer.
2) Long-Distance Power Transfer: Further development can focus on increasing the effective charging range, allowing vehicles to charge even when parked slightly away from the charging pad. This can be achieved by using stronger magnetic fields and better resonant coupling techniques in the hardware.
3) Vehicle-to-Vehicle (V2V) Energy Sharing: The system can be expanded to allow one vehicle to charge another directly through inductive coupling. This will be especially helpful during emergencies when a vehicle's battery is low and there is no charging station nearby. Future designs can include portable V2V chargers for roadside assistance.
4) Integration with Renewable Energy: The system can be integrated with solar or wind power sources to create a complete eco-friendly charging setup. Solar panels can be used to supply energy to the wireless charging pad during the day, reducing dependency on conventional electricity and promoting green energy use.
5) Safety and Protection Improvements: Future versions can include advanced protection circuits to safeguard the system from overheating, overcurrent, or short circuits. Improved insulation, proper shielding, and cooling systems can ensure safe and stable operation even during continuous use.
6) Compact and Portable Design: With further research, the system can be made smaller and easier to install, making it suitable for home garages, parking areas, and public stations. Lightweight materials and modular components can make the system more practical for real-world applications.
7) Standardization and Compatibility: Developing universal standards for coil size, operating frequency, and power rating will make the system compatible with different vehicle models. This will help in creating a common wireless charging platform usable by all EVs.

VI. ACKNOWLEDGEMENT

We owe an enormous debt of gratitude to my Minor Project 1 supervisor, Prof. Anoop Tiwari. for guiding and inspiring me from the beginning through the end of this project with his intellectual advice and insightful suggestions. I truly appreciate and value his consistent feedback on my progress, which was always constructive and encouraging, and ultimately drove me in the right direction. We also owe a lot of thanks to several people who have helped and motivated me throughout my thesis work as well as throughout my undergraduate course at SISTec, Bhopal, in particular, Dr. Manish Billore (Principal, SISTec, Bhopal), Dr. Ravi Shankar Mishra, (Prof.& HOD, Electronics and Communication Department SISTec,Bhopal), all teaching and non-teaching staff of Electronics and Communication Department for their valuable assistance they offered me generously during the past years. We wish to thank our father & our mother, all my family members and my friends for their unwavering faith and belief in me throughout my life.

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TEAM INTRODUCTION

Our team consists of four members with different skills. Our team is dedicated to providing quality results and providing innovative solutions to projects.

Team Members

Shubham Sen
(0187EC221058)

Khushi Soni
(0187EC221027)

Pratham Makoriya
(0187EC221043)

Rubana Ali
(0187EC221051)

Kanchan Sen
(0187EC221025)

Guide: Prof. Anoop Tiwari

- Team Approach: Our strategy is to handle the project and its development by using Agile, which is a flexible way of managing projects. We're planning to use different methods like trying out our product with users, making early models, and regularly updating and checking our work as we go along.
- Team Dynamics: Our team is composed of individuals with a variety of skills and backgrounds, providing us with multiple viewpoints to tackle the project. We aim to work together and keep in constant communication to guarantee the successful completion of the project.
- Conclusion: Our enthusiasm for participating in this project is high, and we're dedicated to achieving outstanding outcomes. Equipped with the necessary skills, expertise, and enthusiasm, our team is poised to successfully bring this project to fruition.

Appendices:

- Project Summary
- Data Sheets
- Budget

PROJECT SUMMARY

About Project

The Wireless Electric Vehicle (EV) Charging System with Vehicle-to-Vehicle (V2V) Support is an advanced and sustainable solution aimed at improving the charging process for electric vehicles. This system operates on the principle of electromagnetic induction, allowing energy to be transferred wirelessly from a transmitting coil to a receiving coil without the need for physical connectors. It provides a convenient, safe, and efficient method of charging electric vehicles simply by positioning them over a charging pad.

The addition of V2V support enables one vehicle to share energy with another, offering a reliable backup option in emergency situations. The project utilizes key hardware components such as coils, rectifiers, and power control units to ensure stable and secure operation. By removing the limitations of traditional wired systems, this project promotes eco-friendly, efficient, and user-friendly charging, paving the way for a smarter and more sustainable future in electric transportation.

Title of the project	WIRELESS EV CHARGING WITH V2V SUPPORT
Semester	7th
Members	Khushi Soni, Kanchan Sen, Shubham Sen, Pratham Makoriya, Rubana Ali
Team Leader	Khushi Soni
Describe role of every member in the project	Kanchan Sen and Rubana Ali – Transmitter circuit design, power control, abstract, objectives, layout design, and final report compilation. Pratham Makoriya, Shubham Sen, and Khushi Soni-Literature survey, simulation documentation, prototype assembly, testing, presentation preparation, and proofreading
What is the motivation for selecting this project?	The motivation behind selecting Wireless EV Charging with V2V Support is to overcome the limitations of traditional plug-in charging systems, which require manual connections and longer charging times. This project aims to provide a convenient, contactless charging solution using wireless power transfer technology, improving efficiency and user experience. The integration of Vehicle-to-Vehicle (V2V) support enables energy sharing between vehicles, promoting continuous mobility, reduced grid dependency, and sustainable energy utilization through renewable sources like solar power.

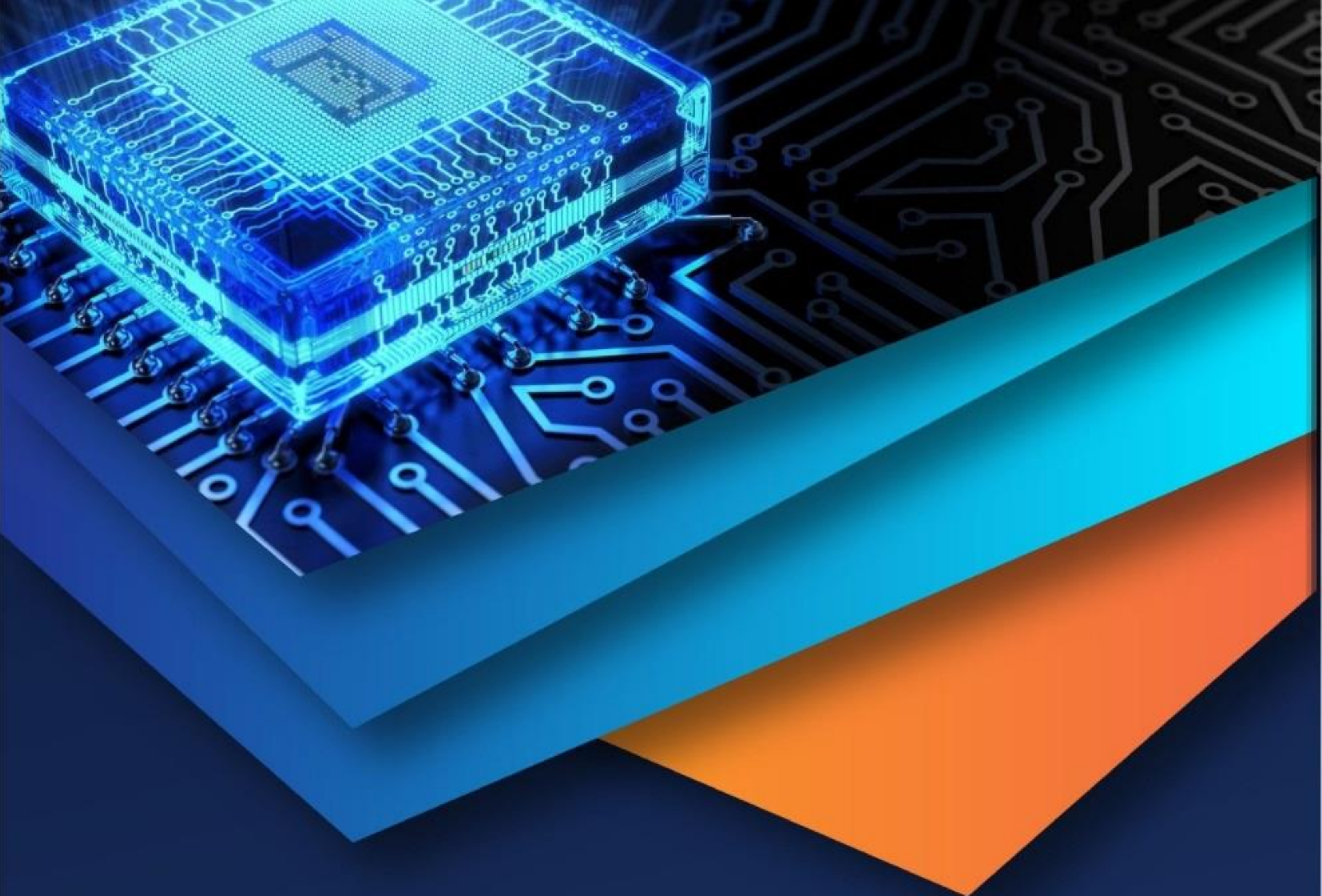
What is the motivation for selecting this project?	The motivation behind selecting Wireless EV Charging with V2V Support is to overcome the limitations of traditional plug-in charging systems, which require manual connections and longer charging times. This project aims to provide a convenient, contactless charging solution using wireless power transfer technology, improving efficiency and user experience. The integration of Vehicle-to-Vehicle (V2V) support enables energy sharing between vehicles, promoting continuous mobility, reduced grid dependency, and sustainable energy utilization through renewable sources like solar power.
Tools &Technologies	Solar Panel, Step-Down Transformer, Buck Converter, Transmitter–Receiver Coil Module, Switch, Lithium-ion Battery, Charging Indicators, Wired V2V Cable, Voltage Regulator Circuit, Jumper Wires, Arduino UNO, Proteus Simulation, and Arduino IDE..
	Guide Signature and name

DATA SHEETS

1. Transmitter Coil
Datasheet: https://components101.com/sites/default/files/component_datasheet/Inductive-Coil-Datasheet.pdf
2. Receiver Coil
Datasheet: https://components101.com/sites/default/files/component_datasheet/Inductive -Coil-Datasheet.pdf Receives magnetic energy from the transmitter coil and converts it into electrical power.
3. Receiver Coil
Datasheet: https://components101.com/sites/default/files/component_datasheet/
4. Switch
Datasheet: https://www.teknic.co.in/pdf/DataSheet-Rotary-Switch-with-Flange.pdf
5. Step-Down Converter
Datasheet: https://www.ti.com/lit/gpn/TPS40222
6. Wired V2V Cable
Datasheet: https://orientrise.net/product/vehicle-to-vehicle-v2v-ev-charging-cable/

BUDGET

Sr. no.	Component	No. of units	Price per unit	Cost
1.	Connecting Wire	5 meter	20	100
2.	V2V Cable	1	-	300
3.	TX Coil	1	-	300
4.	RX Coil	1	-	300
5.	Jumpers	-	-	100
6.	Solar Panel	1	-	1,199
7.	Leds	4	5	20
8.	Li-ion battery	2	-	696
9.	Switch	1	-	25
10.	Step Down CxR	1	-	159
11.	Step Down TxR	1	-	500
13.	Stationary items	-	-	200
14.	Charging Indicators	1	-	125
Total Cost :-				4,024



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