EV to EV Charging Sharing System.

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Abstract: *With the rapid rise in electric vehicle (EV) adoption, the need for cost-effective and accessible charging solutions has become crucial, as traditional infrastructure faces challenges like high costs, limited availability, and grid dependency. This research explores an EV-to-EV charging `system that allows direct energy transfer between vehicles, offering a flexible and decentralized alternative. The system integrates a Battery Management System (BMS), a DC- DC converter, and current-limiting resistors to enable controlled and efficient power transfer, with a 12V lithium-ion battery pack and a step-up/step-down converter ensuring stable voltage regulation. By minimizing energy losses and preventing issues like overcharging and overheating, this approach proves to be a viable solution, especially in remote areas or emergencies, ultimately enhancing EV accessibility, reducing range anxiety, and promoting sustainable transportation.*

Key Words: *Electric Vehicle (EV), EV-to-EV Charging, Smart Charging, Energy Transfer, Vehicle-to-Vehicle (V2V) Charging, Emergency Charging Solution, Power Management.*

1. INTRODUCTION

The worldview move toward zapped transportation environments has required the improvement of inventive vitality conveyance systems to address the inalienable challenges related with electric vehicle (EV) vitality independence, infrastructural confinements, and crisis control exigencies.

The multiplication of EV innovation, whereas instrumental in moderating natural corruption and diminishing reliance on fossil powers, is obstructed by limitations such as charging station shortage, drawn out reviving terms, and extend uneasiness.

To neutralize these hindrances, the concept of EV-to-EV (V2V) vitality transference rises as a transformative approach, encouraging coordinate, controlled, and productive inter-vehicular control trade without the prerequisite of outside charging foundation.

This inquire about endeavours to conceptualize and build a cleverly, decentralized energy-sharing framework wherein a giver EV powerfully designates its put away electrical vitality to a beneficiary EV by means of a controlled DC-to-DC exchange instrument.

The proposed technique coordinating advanced control balance structures, multi-layered security conventions, and exactness voltage direction calculations to guarantee ideal vitality stream, framework astuteness, and user-controlled operation.

By leveraging real-time current stabilization components and progressed defensive circuitry, the framework ensures that the charging prepare isn't as it were mechanically proficient but moreover fundamentally strong and failsafe beneath energetic vehicular conditions.

The natural esteem of this extend lies in its capacity to rethink the scene of EV vitality conveyance, rising above the confinements of customary inactive charging framework. By presenting a versatile, versatile, and infrastructure-independent power-sharing system, this framework is balanced to revolutionize crisis roadside vitality renewal, encourage EV armada vitality redistribution, and reinforce energized versatility in locales with lacking charging offices.

The key usage of independent energy-sharing calculations guarantees that the control trade prepare remains exceedingly optimized, minimizing vitality scattering and maximizing charge maintenance productivity.

This think about embraces a comprehensive investigation of the hypothetical, computational, and test measurements of EV-to-EV vitality transmission. Through thorough framework modelling, observational approval, and real-world prototypical sending, the investigate points to substantiate the versatility, unwavering quality, and down to earth achievability of inter-vehicular control trade standards.

The resultant discoveries will altogether contribute to the progression of next-generation vehicular vitality biological systems, fortifying worldwide maintainability orders, and assisting the move toward completely independent and decentralized energized transportation systems.

2. WORKING EXPLANATION

The EV-to-EV charging circuit starts with the donor EV's battery pack, which consists of three 18650 lithium-ion cells in a 3S configuration, providing a nominal voltage of 11.1V and a fully charged voltage of 12.6V. This battery serves as the primary power source.

The power from this battery first passes through the Battery Management System (BMS), which monitors voltage, current, and temperature to protect the battery from overcharging, over-discharging, and short circuits. The BMS ensures balanced charging across all three cells and disconnects power if any cell reaches unsafe voltage levels.

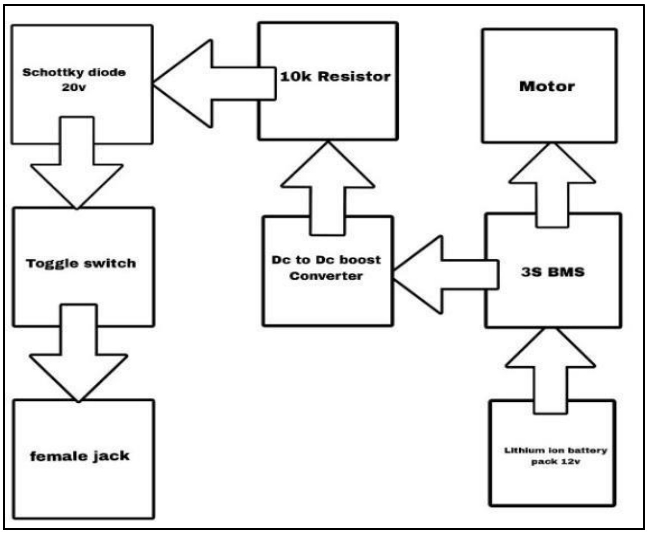

Fig No. 1: Block Diagram Of EV 1 Doner EV.

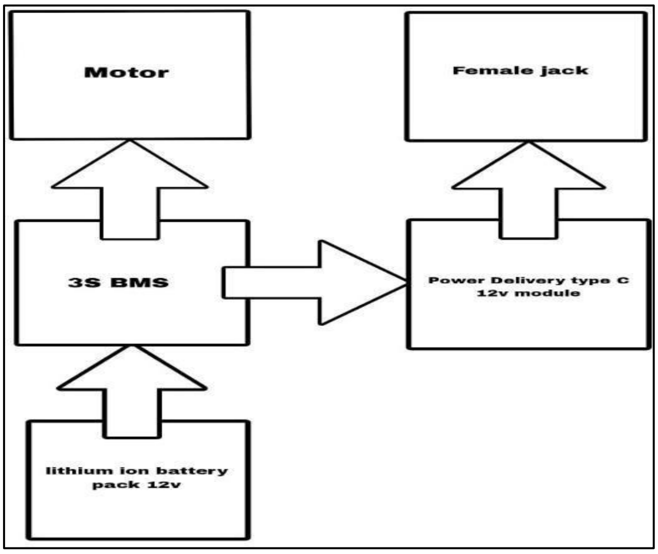

Fig No. 2: Block Diagram Of EV 2 Receiver EV.

After the BMS, the power is sent to a DC-DC buck-boost converter, which stabilizes the voltage at 12V to ensure consistent charging. If the donor battery voltage drops below 12V, the converter boosts the voltage, and if it exceeds 12V, the converter bucks the voltage to maintain stability. The stabilized power then passes through a current-limiting resistor, which restricts the charging current to prevent excessive current flow that could damage the recipient battery. Following this, a Schottky diode is placed in the circuit to allow current to flow in only one direction, preventing reverse current from flowing back into the system.

A toggle switch is included to manually control the charging process, allowing the user to start or stop charging as needed. The power is then transferred through a female jack, which acts as an output port, connecting to a male connector that links to the recipient EV's female jack. From here, the power is delivered to a Power Delivery (PD) Type-C 12V module, which ensures compatibility with Type-C charging systems and regulates voltage accordingly. The power then flows through the recipient EV's BMS, which manages and protects the recipient battery pack, just as the donor BMS does. Finally, the power reaches the recipient EV's lithium-ion battery pack, completing the charging process and ensuring a safe and controlled transfer of energy from one EV to another.

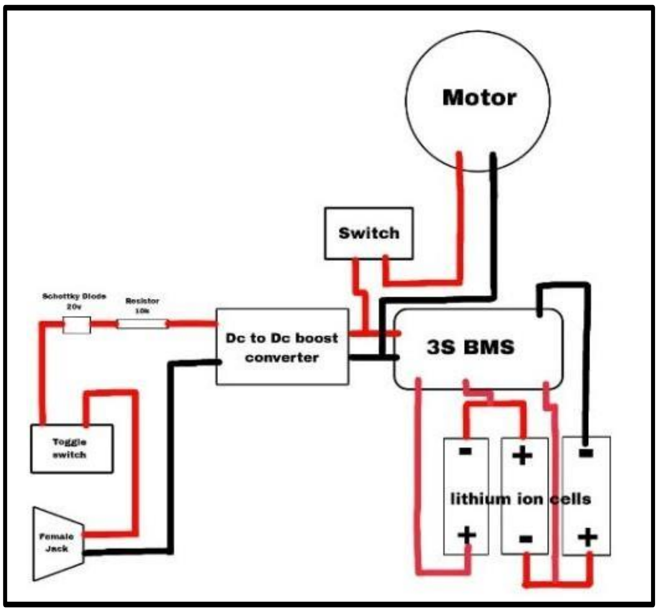

Fig No. 3: Connection Diagram Of EV 1 Doner EV.

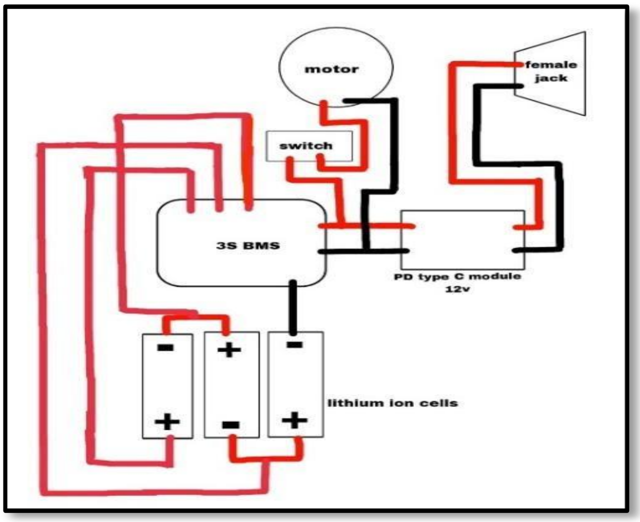

Fig No. 4: Connection Diagram Of EV 1 Doner EV.

Main Components

I. Lithium-ion (Li-ion) cell:

Fig No. 5: Lithium-ion (Li-ion) cell

A lithium-ion (Li-ion) cell is a rechargeable battery with a nominal voltage of 3.7V and high energy density (150-250 Wh/kg). It has a capacity of 1000mAh to 5000mAh, a lifespan of 300-2000 cycles, and supports fast charging. A Battery Management System (BMS) ensures safety by preventing overcharging, overheating, and deep discharge. It is widely used in EVs, laptops, and smartphones.

II. DC – DC Boost Convertor:

Fig No. 6: DC – DC Boost Convertor.

A DC-DC boost converter increases a lower DC voltage to a higher voltage with 80%-95% efficiency. It typically operates with an input voltage of 3V-36V and outputs 5V, 12V, or higher. Commonly used in EVs, solar systems, and battery-powered devices, it ensures stable power for various application.

III. DC Power Delivery:

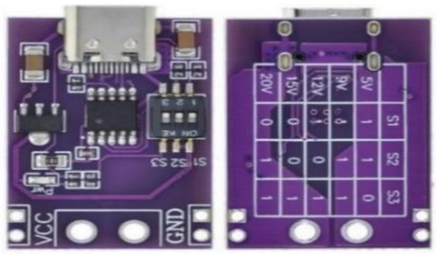

Fig No. 7: DC Power Delivery.

A DC to Power Delivery (PD) 12V module converts a DC input to a regulated 12V output using USB-C PD technology. It supports dynamic voltage adjustment for compatibility with PD-enabled devices. Commonly used in EV charging, laptops, and portable power solutions, it ensures efficient and safe power delivery with overvoltage and current protection.

IV. 3S BMS (Battery Management System):

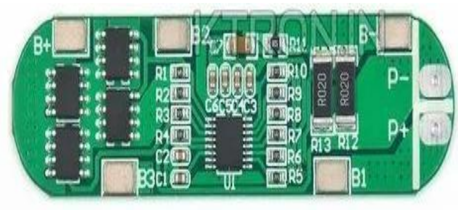

Fig No. 8: 3S BMS (Battery Management System).

A DC to 3S BMS (Battery Management System) is designed for 3-cell (3S) lithium-ion battery packs (nominal 11.1V, full 12.6V). It protects the battery from overcharging, over-discharging, short circuits, and overheating, ensuring balanced charging across all cells. Commonly used in EVs, power banks, and battery packs, it enhances battery safety, lifespan, and performance.

V. Male and Female Jacks:

Fig No. 9: Male and Female Jacks.

Male and female jacks are electrical connectors used for secure power and signal transfer. The male jack has a protruding pin, while the female jack has a receptacle to receive it. They ensure proper polarity, easy connectivity, and reliable power transmission in applications like EV charging, audio devices, and power adapters.

VI. Schottky Diode:

Fig No. 10: Schottky diode

A Schottky diode is a fast-switching, low-voltage-drop diode used for efficient power management. It has a low forward voltage drop (0.2V-0.45V), reducing energy loss and heat generation. Commonly used in DC-DC converters, power supplies, and battery charging circuits, it prevents reverse current flow, improving circuit efficiency.

3. EV TO EV CHARGING STATION: A Decentralized Energy Solution

The EV-to-EV charging system introduces a groundbreaking approach to overcoming the limitations of conventional charging infrastructure, such as high costs, restricted availability, and reliance on the electrical grid. By enabling direct energy transfer between electric vehicles, this system provides a decentralized and flexible alternative, particularly useful in emergencies or remote locations where traditional charging options are unavailable.

A crucial aspect of this system is the integration of a Battery Management System (BMS) and DC-DC converter, which regulate voltage and current to ensure a controlled and efficient power transfer process. These components play a vital role in optimizing charging performance while mitigating risks such as overheating, overcharging, and unnecessary energy loss. Additionally, current-limiting resistors enhance safety by preventing sudden power surges during the charging operation.

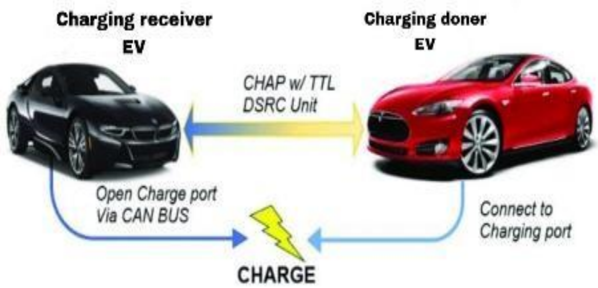

Fig No. 11: Charging Sharing Process.

Experimental findings confirmed that the system effectively manages power distribution, maintaining efficiency and stability under various conditions. The ability to support mobile energy sharing significantly enhances EV accessibility, reduces range anxiety, and fosters the development of peer-to-peer charging networks. This approach challenges the traditional reliance on stationary charging infrastructure, positioning EVs as mobile energy sources capable of dynamic power exchange.

Despite its potential, several challenges must be addressed before widespread adoption, including scalability, interoperability among different EV models, and optimization of energy transfer efficiency. Although initial tests demonstrate feasibility, further improvements are required to enhance charging speed, integrate intelligent communication systems, and refine energy-sharing coordination. Additionally, the long-term effects of frequent energy transfers on battery lifespan and degradation require in-depth analysis to ensure sustainability.

Ultimately, the EV-to-EV charging system represents a significant step toward a more decentralized and resilient EV charging ecosystem.

By reducing dependence on fixed infrastructure and enabling real-time energy exchange, this technology has the potential to transform the future of electric mobility, making charging more accessible, efficient, and adaptable to diverse real-world applications.

Fig No. 12 : Charging Sharing Charged Vehicle to Discharged Vehicle.

4. ADVANTAGES

A. Reliable Backup Charging: In case your EV runs low on battery in a location without charging stations, this system enables you to receive power from another EV, preventing unexpected breakdowns.

B. Convenient Mobile Charging: Unlike conventional charging methods that rely on stationary chargers, EV-to-EV charging allows for flexible charging anywhere, even during a journey.

C. Quick Charging in Remote Locations: Areas with limited charging infrastructure can benefit from direct EV-to-EV power transfer, reducing wait times and making charging more accessible.

D. Cost-Effective Charging Alternative: By sharing or exchanging power with another EV, users can minimize charging expenses, avoiding high fees at commercial charging stations.

E. Enhanced Long-Distance Travel: This technology ensures that EV drivers can embark on longer trips without fear of running out of battery, as they can coordinate charging with other EV users along the way.

5. RESULT

The feasibility of EV-to-EV energy transfer has been validated as an innovative and efficient alternative to conventional charging methods. Experimental tests confirmed the system's capability to sustain consistent voltage and current, facilitating a stable and secure power exchange while minimizing energy loss. By incorporating an advanced Battery Management System (BMS) with a DC-DC converter, the system effectively mitigated potential challenges such as overheating, overcharging, and power inconsistencies.

Moreover, assessments under controlled environments and simulated emergency situations demonstrated its reliability, particularly in remote locations where conventional charging stations are unavailable. These results emphasize the potential of EV-to-EV energy sharing in improving accessibility, addressing range anxiety, and enabling decentralized mobile energy networks. Ultimately, this advancement contributes to the continued development of sustainable electric transportation.

6. CONCLUSION

The EV-to-EV charging system offers a practical and efficient way to transfer power between electric vehicles, reducing reliance on traditional charging stations. By utilizing a Battery Management System (BMS), DC-DC converter, and safety components like Schottky diodes and current-limiting resistors, the system ensures a stable, safe, and controlled charging process. This technology enhances EV accessibility, supports long-distance travel, and contributes to a more sustainable transportation system. As electric vehicle adoption grows, EV-to-EV charging can play a crucial role in expanding charging infrastructure and promoting energy-sharing solutions.

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