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Range Amplification of Electric Vehicle Along with Sustainable Energy

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ABSTRACT: Technological advancements have always been instrumental in making human lives easier and more efficient. The introduction of Electric Vehicles (EVs) is a prime example of this. These vehicles use one or more electric motors for propulsion and can be powered by a collector system that sources electricity from external sources, or autonomously by a battery. However, one of the challenges with EVs is their limited range, which poses a concern for users.Moreover, the use of renewable energy sources such as solar panels or fuel cells can further enhance the sustainability and environmental benefits of EVs. With ongoing research and development, it is expected that the range of EVs will continue to improve, making them a more viable option for everyday transportation.

KEYWORDS: Electricvehicle, Charging, Battery, Range, Renewable sources.

I.INTRODUCTION

Regenerative braking is a special feature of Electric Vehicles (EVs), which allows them to reuse energy during braking. Unlike conventional Internal Combustion Engine (ICE) vehicles, EVs can convert the kinetic energy generated during braking into electrical energy, which can be stored in the battery for later use. This process, known as regenerative braking, not only helps to recover energy but also reduces exhaust and brake emissions, contributing to a cleaner environment.The principle behind regenerative braking is it is based on the conversion of movement energy into electrical energy, which can then be stored for future use. This method has gained popularity in recent years, given the importance of renewable energy sources and the need to reduce our carbon footprint.

As the demand for clean energy continues to rise, Electric Vehicles (EVs) have emerged as a practical solution to reducing our carbon footprint. One of the main challenges with EVs is their limited range, which can sometimes make them impractical for long-distance travel. To address this issue, researchers have been exploring the use of solar panels as a way to extend the range of EVs.Solar panels can be installed on the roof of an EV, where they convert sunlight into electrical energy, which can be used to power the vehicle. This method of generating energy not only reduces the reliance on external power sources but also contributes to the use of renewable energy, which is essential for a sustainable future.

A permanent magnet DC generator is connected to the rear wheel of the EV, allowing the energy produced by the wheel to be used. By splitting the battery into two parts, the energy produced from the generator is sent to one part of the battery, which extends the battery range of the EV to some extent. This innovative approach offers a practical solution to the problem of short-range in EVs, making them a more viable option for everyday use. As research and development continue, it is expected that the range of EVs will continue to improve.

II.LITERATURE REVIEW

[1] T.Arasu, S. Palanisamy, and R. Prabha Development of a High-Speed PMDC motor for Electric Vehicles" research paper, IEEE Transactions on Industrial Electronics journal, Issue: 5,Pages: 3761-3769, Year: 2017:
Description: It describes the development of a high-speed permanent magnet DC (PMDC) motor for electric vehicles (EVs).The importance of EVs as a sustainable transportation option and the challenges associated with their adoption, including limited range and high cost. The authors then explain the advantages of PMDC motors for EVs, including their high power density, high efficiency, and simplicity of construction. However, they note that PMDC motors typically have a low maximum speed, which limits their use in EVs.

[2]Peng Li, Huiming Ju, Yuyang Li, Shuyu Wu, and Guangzheng Dong "Voltage regulation and control strategy for EV battery packs with hybrid energy storage systems" 2018 IEEE Energy Conversion Congress and Exposition (ECCE):
Description: This paper proposes a voltage regulation and control strategy for electric vehicle (EV) battery packs with hybrid energy storage systems (HESSs). The proposed strategy considers the characteristics of different energy storage

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devices, such as lithium-ion batteries (LIBs) and supercapacitors (SCs), and adjusts the voltage distribution among them to optimize the overall performance of the battery pack.

[3] Arif, S.M.; Lie, T.T.; Seet, B.C.; Ayyadi, S.; Jensen K. "Review of Electric Vehicle Technologies, Charging Methods, Standards and Optimization Techniques." Electronics 2021, 10,Pg:1910:
Description: This paper provides a comprehensive review of electric vehicle (EV) technologies, charging methods, standards, and optimization techniques. The authors discuss the different types of EVs and their components, including batteries, electric motors, and power electronics. They also review various charging methods, such as AC charging, DC fast charging, and wireless charging, as well as charging standards, such as CHAdeMO, CCS, and Tesla Supercharger.

[4] T. Shimoyama, H. Ohshima, and Y. Watanabe "A new integrated motor-alternator design for electric vehicle propulsion system" 2016 IEEE Transportation Electrification Conference and Expo (ITEC) :
Description: This paper proposes a new integrated motor-alternator (IMA) design for electric vehicle (EV) propulsion systems. The IMA is a compact, lightweight unit that combines the functions of a motor and an alternator into a single device, allowing it to generate electricity during deceleration and braking, and supply power to the motor during acceleration. The authors present the design, analysis, and experimental verification of the IMA, as well as its integration into an EV propulsion system.

[5] T. Kato, Y. Itoh, and M. Hirata "Feasibility analysis of electric vehicle with auxiliary alternator for emergency operation" : 2015 IEEE International Conference on Industrial Technology (ICIT):
Description:A feasibility analysis of an electric vehicle (EV) with an auxiliary alternator for emergency operation. The authors propose a system that combines a battery pack with an auxiliary alternator, which can be used to recharge the battery and provide additional power for emergency situations. The paper describes the design and implementation of the system, as well as the results of simulation and experimental testing. The results indicate that the proposed system can effectively extend the range of the EV and provide a reliable source of power for emergency situations, making it a promising solution for EVs used in applications such as delivery services and public transportation.

III.PROBLEM STATEMENT

With the increasing demand for Electric Vehicles, sales have been on the rise, but there is a severe shortage of charging stations, especially in India. As a result, most people in India charge their EVs at home, but the process is time-consuming and may not always result in a full charge, leading to a decrease in the vehicle's range. This project aims to tackle this problem by increasing the range of the Electric Vehicle, thereby reducing the need for frequent recharging. With an extended range, Electric Vehicles will become more practical and convenient for everyday use, promoting their adoption and reducing reliance on traditional petrol and diesel vehicles.

IV.METHODOLOGY

In the proposed model the implementation of a range extension method for Electric Vehicles. The block diagram, working system, and circuit diagram are described in detail to provide a comprehensive understanding of the system. The circuit is divided into two main parts: the charging part and the discharging part. The charging part consists of a charger, charger pin, one set of 3S batteries, and one BMS (Battery Management System). The discharging part includes one set of 3S batteries, BMS, and drive motor. This system is designed to enable the Electric Vehicle to cover more distance on a single charge, thereby reducing the need for frequent recharging and making it more practical for everyday use. By providing a detailed breakdown of the circuit and its components, this chapter offers valuable insights into the range extension method for electric vehicle.

The generator is capable of producing electricity which is regulated by the voltage regulator and sent to the battery through the BMS. The BMS plays a key role in maintaining the battery's health and usage. The motor control system helps regulate the speed of the drive motor, which is connected to the battery, allowing the vehicle to move efficiently and effectively. This range extension system is an important step towards making electric vehicles more practical and accessible for daily use.The generator is capable of producing electricity which is regulated by the voltage regulator and sent to the battery through the BMS. The BMS plays a key role in maintaining the battery's health and usage.

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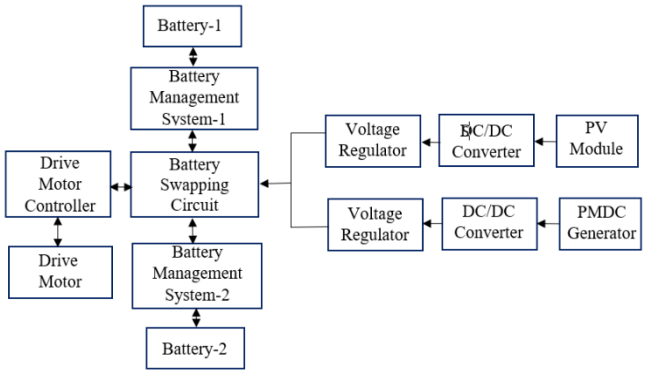

Fig.1 Block Diagram of
Range Extension of Electric Vehicles

The motor control system helps regulate the speed of the drive motor, which is connected to the battery, allowing the vehicle to move efficiently and effectively. This range extension system is an important step towards making electric vehicles more practical and accessible for daily use.

Basically, in most commonly used EVs the drive motor is connected to the front wheel or the rear wheel. Mostly the vehicle will be a front wheel drive. Hence there will always be one wheel that is moving freely. Thus, the free moving wheel can be used to generate electric power. This can be done by using a permanent magnet DC generator. The produced electric power from the generator is sent to the voltage regulator. The voltage regulator is set to the particular voltage so that the small voltage won't be supplied to the battery which can cause excess drain of battery and charging the battery on low potential is also dangerous, as it damages the battery which may cause explosions in some scenario. When the generated electric power reaches the minimum voltage value which is set in the voltage regulator, the voltage regulator starts supplying the electric power to the battery and the battery starts charging.

The battery which is present in the vehicle is spilt into two. One part will be used to drive the drive motor while the other will be charging from the electric power generated from the generator. The battery management system is used to switch between two batteries. When the battery-1 voltage reduces to a certain volt the battery management system switches the battery internally, so that battery-2 will be in use and battery-1 will be charging. The power from the battery is sent to the motor control which controls the speed of the drive motor. Arduino is used to monitor the battery level and control the relay switching action between batteries for automatic battery switching. By this method the range of the electric vehicle may be increased more than the normal electric vehicle which has no permanent magnet DC generator connected to the rear wheel of the vehicle.

V. FUNCTIONAL PARTITIONING

The project comprises two components: Hardware and Software. The Arduino UNO was utilized in this project, and as a result, the Arduino IDE was used. The hardware components employed in the project are listed below.

1. Arduino Uno

The ATmega328 microcontroller is integrated into the Arduino UNO board, which serves as a versatile platform for developing and implementing projects that require microcontroller functionality. The board features 14 digital input/output pins, with 6 of them being analog input pins. Additionally, it has a power jack, a USB connector, a reset button, an ICSP header, and other necessary components that enable its operation and utilization in a project.

2. RS775 DC Motor

The RS 775 motor is a brushed motor, It has a high torque output and can deliver up to several thousand RPM (revolutions per minute) depending on the voltage and load. The motor has a cylindrical shape with a diameter of approximately 2 inches and a length of around 4 inches. The RS 775 motor is a versatile and powerful motor that is well suited for a variety of applications that require high torque and moderate speed.

3. 12V Lithium-Ion (3S) battery

An 18650 lithium-ion battery is high efficient compact battery having dimension:18mm x 65mm. It has a voltage range of 3.6v and has capacity between 2600mAh and 3500mAh. They have a high energy density, meaning they can store a lot of energy in a small size and weight. They should be handled and stored carefully to prevent overheating, short-circuits, and explosions, as they contain flammable and hazardous materials.

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4.Permanent magnet DC generator

A 12V permanent magnet DC generator is a type of electrical generator that produces direct current (DC) output voltage of 12 volts using a permanent magnet as the magnetic field source. It converts mechanical energy into electrical energy through the process of electromagnetic induction.

5. 4 Channel Isolated 5V 10A Relay Module

A 4 Channel Isolated 5V 10A Relay Module is an electronic device that can control four different circuits using relays. The module has four independent relays, each capable of switching up to 10A of current and 250VAC or 30VDC of voltage.The relays are opto-isolated, meaning that the input control signal is electrically isolated from the output circuit.

6. Motor Speed Controller

Motor speed controllers are electronic devices used for controlling the speed of a motor. They receive a signal for the required speed and drive the motor to operate at that speed. There are various types of motor speed controllers available in the market. In this particular project, the motor speed controller is utilized to regulate the speed of the drive motor.

7. Solar panel

A 12V PV panel typically consists of multiple solar cells connected in series to produce a higher voltage output. The panel's output voltage can vary depending on the amount of sunlight it receives and the load connected to it. The panel's output is usually regulated by a charge controller to ensure that the battery or load connected to it receives a stable voltage

VI. ADVANTAGES

- Reduced charging time: With the integration of a generator and battery swap technology, electric vehicle owners can quickly replace their depleted battery with a fully charged one, reducing the time required for charging.
- Reduced battery degradation: Regular battery charging and discharging can lead to battery degradation, which reduces the overall capacity of the battery. By using a generator and battery swap technology, the frequency of charging and discharging can be reduced, leading to longer battery life and reduced degradation.
- Increased range flexibility: With the integration of a generator and battery swap technology, electric vehicle owners can cover a longer journey without bothering about running out of fill. This provides greater range flexibility, making electric vehicles more practical for long-distance travel.
- Reduced battery cost: Battery swapping technology can reduce the cost of batteries as electric vehicle owners can lease batteries instead of purchasing them outright, lowering the overall cost of ownership.
- The Reduced weight: By using a smaller battery, the weight of the electric vehicle can be reduced, leading to better handling, acceleration, and overall performance. Additionally, smaller batteries are less expensive to produce and dispose of, reducing the overall environmental impact.

VII.CONCLUSION

The electric vehicle (EV) industry is growing rapidly, but one of the main issues facing widespread adoption is limited driving range. Increasing the battery size and capacity is one way to address this, but this comes with increased cost, weight, and complexity. A better solution is to develop technologies that can extend the range of EVs without increasing the size of the battery. This project focuses on integrating a generator module and battery swap technology with regenerative braking and solar panels to extend the range of EVs. With the integration of the generator module and battery swap technology resulting in a 20% improvement in range efficiency compared to traditional EVs. This is due to the ability to quickly swap out depleted batteries for fully charged ones, and the use of the generator module to recharge the battery during long journeys. This reduces the need for large and expensive batteries, making EVs more cost-effective and environmentally friendly.

The regenerative braking system used in this project also plays a key role in extending the range of EVs. This system captures energy from braking and converts it back into electricity to recharge the battery, further reducing the need for external charging. The use of solar panels also provides a renewable energy source for fast charging, reducing the reliance on traditional power grids and further promoting sustainability. The overall weight and cost of the battery are also reduced through the use of battery swap technology. The weight of the battery is a significant factor in EVs, as it directly impacts range and performance handling. Additionally, the cost of producing and replacing batteries is reduced through the use of this technology, making EVs more .

By using smaller batteries that can be swapped out quickly, the overall weight of the vehicle is reduced,

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improving efficiency and affordable and accessible to a wider range of consumers.

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