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Supercapacitor Based Electric Vehicle

Dr. M. Ulagammai
Associate Professor,
Department of Electrial and Electronics Engineering.
Saveetha Engineering College
Chennai-60210,Tamil Nadu, India.
ulagammai@saveetha.ac.in ;
ORCID ID: 0000-0002-4771-1593

Manoj S.S
Final year U.G Student,
Department of Electrial and Electronics Engineering.
Saveetha Engineering College
Chennai-60210,Tamil Nadu , India.
manojshanmugam63@gmail.com

Hariharan K.
Final year U.G Student,
Department of Electrial and Electronics Engineering
Saveetha Engineering College
Chennai-60210,Tamil Nadu , India.
hariharan18092001@gmail.com

Praveen S
Final year U.G Student,
Department of
Electrial and Electronics Engineering
Saveetha Engineering College
Chennai-60210,Tamil Nadu, India.
praveen.sec.30@gmail.com

Kasthurirangan P.A
Final year U.G Student,
Department of
Electrial and electronics engineering
Saveetha Engineering College
Chennai-60210,Tamil Nadu, India
Kasthurirangan222@gmail.com

Abstract **-By steadily lowering carbon emissions from our planet,we can preserve a greener and safer world. The usage of electric automobiles,that utilize generated fuel for electricity,emits fewer emissions than a typical vehicle,and if renewable electricity is utilised, it is emission-free.,will generally result in a significant reduction in the mount of fossil fuel-powered vehicles on the road. Now adays, supercapacitors are frequently employed. These ultracapacitors or electrochemical double-layer capacitors are high-pressure, high-efficiency energy storage devices (EDLC). They can be quickly charged and discharged without sacrificing performance an extended length of time, which is one of their advantageous qualities that makes them perfect for use in energy storage systems. HESS, which incorporates multiple power reserve methods, can use a supercapacitor pack.**

I. Introduction

Electric powered vehicles (EV) of all types may be seen more frequently in modern deliveries, including electric-powered motorbikes, electric-powered scooters, and electric powered buses. The ecology and performance of each EV are the driving forces behind the increase in the number of them on the road. Therefore, EVs consume substantially less electricity and are less expensive to operate even though they are more expensive to purchase. In order to improve garage performance, it is important to Highly effective additives for electric energy storagein terms of their length, cost, cycle performance, longevity, power density, and energy density. By storing the energy from acceleration to deceleration, a hybrid energy storage system (HESS) made of battery and supercapacitor components could improve the overall performance of electric vehicles.

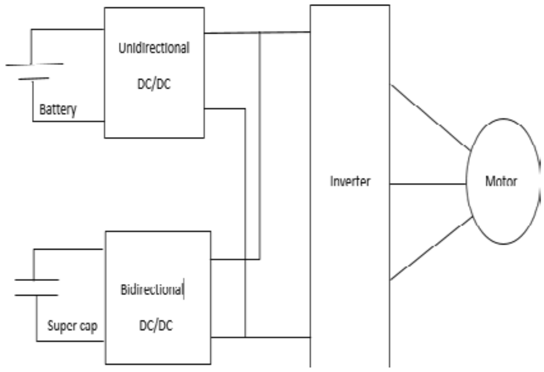
II. Existing System

Maximum amount of power may often be extracted from an ambient energy sourc e in two steps, followed by a DC-DC conversion.It is difficult to regulate the output at the same time because the input impedance of an energy harvesting circuit needs to be regulated for maximum power extraction.Due to its parasitic series resistance, the additional inductor results in a larger form fa ctor, higher price, and greater power loss.

III. Methodology

Applications forEV andHEVhave been present. Energy storage used an auto-motive application must meet a variety of criteria, including particular energy, specific power, efficiency, affordability, environmentalfriendliness, and safety.Specific energy allocation for EVs is prioritised because it affects the vehicle's range. However, since all of the energy in a HEV application comes from theenergy source and sufficient power is required to ensure vehicle performance, particularly during acceleration, hill climbing, and regenerative braking, specific energy becomes less significant and the first factor is specific power. Battery manufacturers frequently specify battery capacity (amp-hours), which is calculated as the number of amp-hours acquired after draining the battery from a fully charged condition until the terminal voltage hits the cut-off voltage.The specific energy of an ultracapacitor is in the region of a few watt-hours per kilogramme. However, it has a far higher specific power than any battery, up to 3 kW/kg. It is challenging due to their low specific energy density and reliance on the SOC to use ultracapacitors alone as an energy storage for EVs and HEVs.The ultracapacitor's load levelling effect reduces the battery's high-current charging during reverse braking as well as high-current discharging from the battery, which greatly extends the battery's life and energy capacity. We attached the lithium-ion battery and ultracapacitor for that reason.

Block Diagram



IV. Components

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A. Super Capacitor

Super-capacitors, a novel technology in the field of transportation, are suitable power components for HEVs' energy storage systems. They are dense in power is substantially superior to batteries and they have a lifespan of over 500,000 cycles.Ten times more energy can be held in a supercapacitor than can be in an electrolytic capacitor. Their quick adoption for automotive applications is a result of theirpower and life cycle properties, which are far superior to high power batteries.Two theories are put out in the literature to model the behaviour of super-capacitors. The first approach, which in accordance with the transmission-line model, suggests a circuit equivalent that uses distributed capacitance Ci and pore resistance Ri, which characterises the behaviour of the supercapacitor by means of an electrical equivalent circuit with two RC branches. C1 is modelled as a differential capacitor with voltage dependence., the first branch. It consists of a constant capacitor C0 and a variable capacitor Cv whose value changes linearly with voltage V1. Serial resistance comparable to R1 is R1. The two branches model is a simpler design and requires less simulated period than the first solution.

The major and rapid branch that replicates the predominate supercapacitor charging and discharging behaviour is represented by the R1C1 branch.

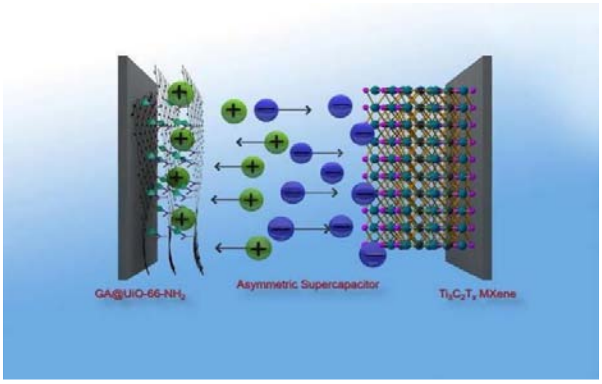

Fig 1. Schematic diagram of super capacitor

B. Lithium Ion Battery

By creating a difference in potential between two electrodes—one negative and the other positive—that are immersed in an electrically conductive ionic liquid known as the electrolyte, the lithium-ion battery operates on the principle of circulating electrons.The discharging phase of a battery occurs when a device is powered by it; during this time, electrons that have accumulated in the negative electrode are freed and move to the positive electrode via an external circuit.The opposite hand, as soon as the battery being charged, Electrons are moved back from the positive electrode to the negative electrode by the energy from the charger.Ion types, electrode substance, and related electrolytes are variable between the various battery kinds.For instance, a combustion engine vehicle's starter is typically powered by a 12-volt lead-acid battery that uses lead-based electrodes and an electrolyte containing lead ions. The lithium-ion battery uses lithium ions (Li+), which is how this technology got its name. A lithium-ion battery, like the one found in a vehicle like the ZOE, is made up of a collection of separate battery units (cells), which are interconnected and under the control of a specific electronic circuit.The battery's capacity, or the quantity of electricity it can store, is determined by quantity of cells, how big each cell is, and arrangement where they are placed.

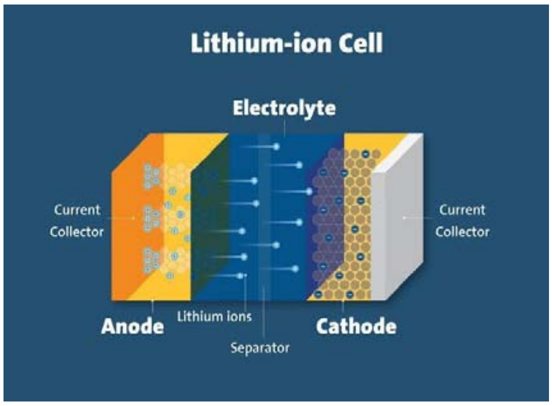

Fig 2.Schematic Diagram of Lithium IonBatteries

C. DC-DC Convertor

A circuit or electromechanical device called a DC-to-DC converter adjusts a direct current source's voltage level. Low to extremely high power levels.These days, electric vehicles are the principal applications for this bidirectional converter. Another name for It's a DC-DC.half-bridge converter.The circuit that results, which generally similar structure to the basic Buck and Boost structure though with the combined bidirectional power flow properties, is known as a dc-dc converter that operates both ways when the boost converter and the Buck are connected in opposition to one another across one another. It functions both ways.Automobile manufacturers typically use electric propulsion based on renewable energy sources rather than engines with combustion, which is the main source of emissions of greenhouse gases. Hydrogen is converted into electrical energy via FC, a clean, economical, and effective renewable energy source. A DC-DC boost converter must be used as the interface for power due to the requirements for driving, longevity, and Reliability of FCs and electric cars based on FCs

Fig. 3 DC-DC Converter

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V. MATLAB Output

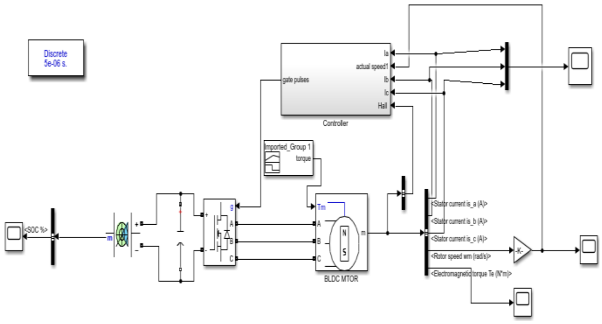

Fig 4. Circuit diagram of Supercapacitor based electric vehicle

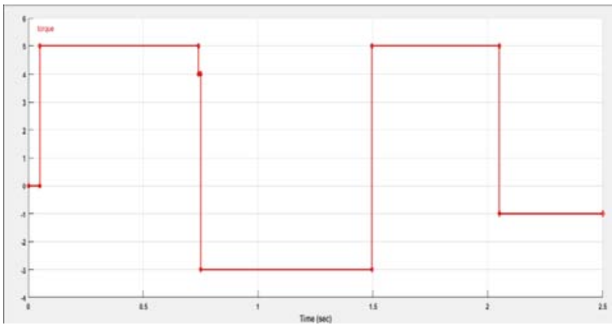

Fig 52. Measurement of torque

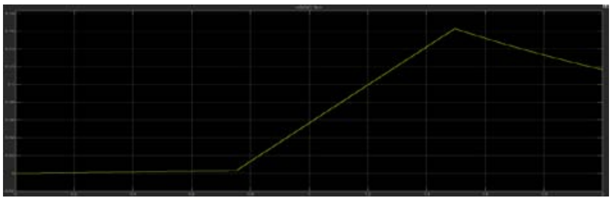

Fig 6. State of charge graph

VII. Conclusion

The hybrid energy storage system (HESS) design case for the application of a hybrid electric vehicle is described and analysed in this paper. A set of super-capacitors and a set of Li-ion batteries make up HESS. The design process seeks identify best device parameters in accordance with a suggested set of standards. It is also done to compare the two topologies for DC/DC convertersthat connect the To the DC, HESS connection. A traditional Buck/boost and DC/DC boost TL boost, buck/boost, and converter are two topologies were explored. According to the results, TL converters provide the optimum exploitation for high energy and high power densities, as well as decreased cost, weight, and volume in the vehicle, of battery and supercapacitor technologies. Models of batteries, supercapacitors, and Several DC/DC converter topologies are used using Matlab/Simulink. Results of the system performance and behaviour are obtained and discussed.

These results validate the TL topology's cost effectiveness and design assumptions.

Reference

[1] Z. Li, A. Khaligh, and O. Onar, "Multiple Input DC/DC Converter Design and Control for a Battery/Ultracapacitor Based Electric Vehicle Power System", 2009's 24th Annual IEEE APEC.

[2] S.M. Lukic, J. Cao, R.C. Bansal, F. Rodriguez, and A.Emadi, "Energy storage systems for automotive applications",vol. 55, no. 6, pp. 2258-2267, 2008, IEEE Transactions Industrial Electronics.

[3] A.C.Baisden, and A.Emadi, "An ADVISOR-based model of a battery and an ultra-capacitor energy source for hybrid electric vehicles",vol. 53, no. 1, pp. 199-205, 2004, IEEE Transactions on Vehicular Technology.

[4] J. Cao, D. Bharathan, and A.Emadi, "Efficiency and loss models for significant electronic components in the electrical propulsion systems of hybrid and plug-in hybrid electric vehicles",IEEE VPPC, Proceedings, pp. 477–482, 2007.

[5] Moshika, A., Thirumaran, M., Natarajan, B., Andal, K., Sambasivam, G., &Manoharan, R. (2021). Vulnerability assessment in heterogeneous web environment using probabilistic arithmetic automata. IEEE Access, 9, 74659-74673.

[6] D. Hoelscher, A. Skorcz, Y. Gao, and M.Ehsani, "Hybridized Electric Energy Storage Systems for Hybrid Electric Vehicles," IEEE VPPC Proceedings, pp. 1-6, 2006.

[7] Rajesh, M., &Sitharthan, R. (2022). Image fusion and enhancement based on energy of the pixel using Deep Convolutional Neural Network. Multimedia Tools and Applications, 81(1), 873-885.

[8] J, Cao, and A.Emadi. "A new battery/ultra-capacitor hybrid energy storage system for electric, hybrid, and plug-in hybrid vehicles", Vehicle Power and Propulsion Conference, Proceedings, pp. 941–946, 2009.