DESIGN AND IMPLEMENTATION OF EFFICIENT MULTIOUTPUT FOR DC-DC CONVERTER FOR EV'S APPLICATION

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ABSTRACT:

Multiport converters play a significant role in portable electronic and electric vehicle (EV) applications. The literature presents different configurations of single-input multi-output (SIMO) converters. Most of the SIMO converters generate the outputs with operating constraints on the duty ratio and charging of inductors. The cross-regulation problem is still a challenge in SIMO converter design. SIMO topology is proposed in this study to overcome the limitations mentioned earlier. It can generate three different output voltages without constraint on the duty cycle and inductor currents (like iL1 > iL2 > iL3 or iL1 < iL2 < iL3). Overall, this new multioutput DC-DC converter presents a promising solution for efficient power management in electric vehicles, contributing to the advancement of sustainable transportation and the widespread adoption of electric mobility.

Keywords: Multiport converters, single input multi output converters.

INTRODUCTION*:* In the past decade, there has been an increase in demand for renewable energy sources utilization in electric vehicles (EVs), auxiliary power, and grid-connected applications. In these applications, multiport DC-DC converters are essential for Hybridizing energy sources which leads to, a reduction the component count, complexity, and cost of the system compared to several separate single-input DC-DC converters. Over the past decade, MPC converters have been presented. A new SIMO converter is proposed in. This structure simultaneously generates boost, buck, and inverted outputs controlled independently. However, producing 'n' voltage levels requires n + 2 switches, which increases the overall size and cost of the converter. Unexpected mistakes in calculating state-space equations and output voltages for a SIMO converter given in are addressed and rectified in**.** The single coupled inductor-based SIMO buck is presented in with a lesser output inductor current ripple than single inductor SIMO converters. Nayak and Nath elaborately presented the comparative performance of SIDO converters based on the coupled inductor and singleinductor (SI) in terms of cross-coupling issues. Furthermore, they proposed that the coupled inductor SIDO converter has a better steady state and transient performance.

Nevertheless, in aSI SIMO configuration inductor is switched between the loads, which causes high ripples and cross-regulation problems. Different control approaches are proposed in the literature to overcome the cross-regulation issue in a single inductor-based SIMO converter; the current predictor controller is presented in instead of the conventional charger balance approach. However, generating the duty ratios for active switches has been somewhat complicated. Similarly, the deadbeat-based control approach is presented in .

Objectives:

A new SIMO converter topology is introduced that uses a single switch and is not isolated. This design has fewer components and reduces system cost. However, it can be difficult to regulate the outputs independently. To address this issue, a non-isolated SIMO converter has been proposed in which the output voltages can be regulated independently, without requiring an additional control circuit.

A new SIDO converter topology has been proposed for generating the step-up and step-down output voltages in electrical vehicle applications. The topology integrates buck and super lift converter but has a constraint on the duty ratio, which limits the operation range of D1 by increasing D2. The proposed topologies have fewer semiconductor switches, but the converter operation is based on the charging time of inductors, keeping the constraint on duty ratio (i.e. $iL1 > iL2$).
The combination of high gain step-up and SEPIC converter-based SIMO is suggested for PV applications in . In this configuration, both the outputs are higher than the supply voltage and improve the output voltage by adding the capacitors and diodes. Nevertheless, the number of capacitors and diodes affects cost and conduction losses. A new SIDO buck-boost topology is developed into generate positive and negative outputs

LITERATURE SURVEY:

The idea to employ electric motors to drive a vehicle surfaced after the innovation of the motor itself. From 1897 to 1900, EVs became 28% of the total vehicles and were preferred over the internal combustion engine (ICE) ones But the ICE types gained momentum afterwards, and with very low oil prices, they soon conquered the market, became much more mature and advanced, and EVs got lost into oblivion. A chance of resurrection appeared in the form of the EV1 concept from General Motors, which was launched in 1996, and quickly became very popular. Other leading carmakers, including Ford, Toyota, and Honda brought out their own EVs as well.

Toyota's highly successful Prius, the first commercial hybrid electric vehicle (HEV), was launched in Japan in 1997, with 18,000 units sold in the first year of production. Today, almost none of those twentieth-century EVs exist; an exception can be the Toyota Prius, still going strong in a better and evolved form. Now the market is dominated by Nissan Leaf, Chevrolet Volt, and Tesla Model S; whereas the Chinese market is in the grip of BYD Auto Co., Ltd (Xi'an National Hi-tech Industrial Development Zone, Xi'an, and China). Road conditions are not similar in all places, it changes with application, environment, and climate. In cities at different sectors like schools, there are speed breakers of different dimensions.

At certain conditions road goes straight without any pits otherwise, we found irregularity. Most of people buy only one 4-wheeler which they use in all these conditions. Hence it's necessary to give some standard ground clearance to the vehicle. But still, there are some restrictions to drive the car on highways and in the city.

Any vehicle that has more than one power source can be considered a hybrid electric vehicle (HEV). But this name is used most often for a vehicle using for propulsion a combination of an electric drive motor and an ICE, whose energy source is a fossil fuel. The first patent involving HEV technology was filed in 1905 by the American H. Piper.

The alteration of center to cross-breed innovation was done by nearly all vehicle producers. Numerous models and a few mass-delivered vehicles are presently accessible. For illustration, there were 23 crossover electric displays at the North American Universal Auto Appear (NAIAS) in 2000.

There are a few setups of electric and half-breed vehicles: 1. electric vehicles prepared with electric batteries and/or supercapacitors called BEV (Battery Electric Vehicles),2. crossbreed electric vehicles which combine customary drive based on ICE motor with petroleum fuel and electric drive with an engine fueled by batteries or supercapacitors called HEV(Hybrid Electric Vehicles), 3. electric vehicles prepared with fuel cells, called FCEV (Fuel Cell Electric Vehicles).

cross breed electric vehicle is distinguee from a standard ICE driven by four distinctive parts: a) a gadget to store a expansive sum of electrical vitality, b) an electrical machine to change over electrical control into mechanical torque on the wheels, c) a altered ICE adjusted to cross breed electric utilize, a transmission framework between the two diverse impetus procedures. Figure 1 appears the conceivable subsystems of a cross breed vehicle arrangement. Whereas the sending of plug-in EVs can deliver rise to different natural and well-being changes, their selection to date has been disillusioning.

Concurring to beginning reports , indeed in Europe, where the green plan was well gotten, less than 12 000 EVs were sold in the to begin with half of 2012 (of which as it were 1000 of these were sold in the UK). This number spoken to less than 0.15% of add up to modern car deals in that year. These figures were in show disdain toward of the reality that numerous European governments had advertised motivating forces for the buy of EVs in the shape of appropriations and had too contributed in empowering framework. There are in any case clues that the numbers may before long drastically alter. For occurrence, developing 59% year over year (YoY), around 12,000 electric cars were sold over the US in January 2017, bookkeeping for around 1% of US auto deals .

So also, the Chinese advertise had more than 32 000 unused electric cars on the lanes in Walk 2017, an 89% increment over the same month the past year, with the yearly development rate at 31%2. Numbers in Europe stay conflicting, with Northern nations driving the advertise (e.g., in 2017 Norway has the most elevated per capita number of all-electric cars in the world: more than 100,000 in a nation of 5.2 million individuals. Be that as it may, things appear to be speeding up, as of late Volvo has declared that all unused cars propelled from 2019 onwards will be in part or totally battery-fueled. The company called this step a “historic end” to building models that as it were have an inside combustion motor. The day after the Volvo declaration, Emmanuel Macron’s government declared that France will conclude deals of petrol and diesel vehicles by 2040.

METHODOLOGY

1.INTRODUCTION:

The purpose of this methodology report is to outline the systematic approach used in the design and implementation of an efficient multi-output DC-DC converter tailored for electric vehicle (EV) applications. The report covers key stages from requirements definition to validation, ensuring optimal performance, reliability, and safety.

2. Requirements Definition:

Define specifications including input voltage range, affair voltage situations, affair current conditions, effectiveness targets, size and environmental conditions. Specify regulatory requirements and standards compliance for EV applications

3. Topology Selection:

Estimate colorful DC- DC motor topologies(e.g., buck, boost, buck-boost, SEPIC, Cuk) grounded on requirements. Select a topology considering factors similar as effectiveness, regulation characteristics, and felicity for multi-output operations.

4. Component Selection:

Choose semiconductor devices and passive components optimized for low losses and high reliability. Select components considering voltage and current ratings, ESR, thermal characteristics, and size constraints.

5. Control Strategy:

Develop control algorithms tailored to the selected converter topology and application requirements. Implement PWM control for output voltage regulation and efficiency optimization. Consider advanced control techniques for improved dynamic response and accuracy.

6. Efficiency Optimization:

Optimize design for maximum efficiency across the load range. Employ techniques such as synchronous rectification, soft switching, and interleaved operation. Utilize high-efficiency magnetic components and minimize parasitic elements.

7. Protection and Safety Features:

Incorporate protection mechanisms including overcurrent protection, overvoltage protection, undervoltage lockout, and thermal shutdown. Ensure galvanic isolation between input and output stages for safety and reliability.

9. Simulation and Validation:

Model and simulate converter performance using tools like SPICE or MATLAB/Simulink. Validate design through hardware prototyping and testing, considering efficiency, transient response, thermal performance, and reliability.

CONCLUSION:

The structure of the SIMO converter is proposed in this project. The operating principle and modes of operation have been explained in detail. The configuration is simple and without assumptions on the charging of inductors and operating duty cycle. It can generate the buck, boost, and buck-boost output voltages with independent regulated voltages. Cross regulation problems do not exist in the topology, so the sudden change in inductor and load currents doesnot affect the output voltages. Finally, simulation results validate the proposed converter operation and performance.

REFERENCES:

1] P. C. Heris, Z. Saadatizadeh, and E. Babaei, ‘‘A new two input-single output high voltage gain converter with ripple-free input currents and reduced voltage on semiconductors,’’ IEEE Trans. Power Electron., vol. 34, no. 8, pp. 7693–7702, Aug. 2019, doi: 10.1109/TPEL.2018.2880493.

[2]A. Farakhor, M. Abapour, and M. Sabahi, ‘‘Design, analysis, and implementation of a multiport DC–DC converter for renewable energy applications,’’ IET Power Electron., vol. 12, no. 3, pp. 465–475, Mar. 2019.

[3] S. K. Mishra, K. K. Nayak, M. S. Rana, and V. Dharmarajan, ''Switchedboost action based multiport converter,'' IEEE Trans. Ind. Appl., vol. 55, no. 1, pp. 964–975, Jan./Feb. 2019.

[4] X. Lu, K. L. V. Iyer, C. Lai, K. Mukherjee, and N. C. Kar, ''Design and testing of a multi- port sustainable DC fast-charging system for electric vehicles,'' Electr. Power Compon. Syst., vol. 44, no. 14, pp. 1576–1587, Aug. 2016.

[5] E. Babaei and O. Abbasi, ''A new topology for bidirectional multi-input multi-output buck direct current–direct current converter,'' Int. Trans. Electr. Energ. Syst., vol. 27, no. 2, pp. 1– 15, Feb. 2017.

[6] Z. Rehman, I. Al-Bahadly, and S. Mukhopadhyay, ''Multiinput DC–DC converters in renewable energy applications—An overview,'' Renew. Sustain. Energy Rev., vol. 41, pp. 521–539, Jan. 2015.

[7] G. Chen, Y. Liu, X. Qing, and F. Wang, ''Synthesis of integrated multi-port DC–DC converters with reduced switches,'' IEEE Trans. Ind. Electron., vol. 67, no. 6, pp. 4536–4546, Jun. 2019.

[8] B. Faridpak, M. Farrokhifar, M. Nasiri, A. Alahyari, and N. Sadoogi, ''Developing a super-lift Luo-converter with integration of buck converters for electric vehicle applications,'' CSEE J. Power Energy Syst., vol. 7, no. 4, pp. 811–820, Jul. 2021, doi: 10.17775/CSEEJPES.2020.01880.

[9] O. Ray, A. Josyula, S. Mishra, and A. Joshi, ''Integrated dual-output converter,'' IEEE Trans. Ind. Electron., vol. 62, no. 1, pp. 371–382, Jan. 2015.[18] G. Chen, Y. Deng, J. Dong, Y. Hu, L. Jiang, and X. He, ''Integrated multiple-output synchronous buck converter for electric vehicle power supply,'' IEEE Trans. Veh. Technol., vol. 66, no. 7, pp. 5752–5761, Jul. 2017.