RENEWABLE ENERGY BASED SEPIC CONVERTER

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Abstract— A new high gain SEPIC-based converter is presented in this paper. The introduced topology provides many benefits, namely very high step-up voltage gain, positive output voltage, high efficiency, and easy control method. Additionally, due to the fact that the proposed SEPIC converter is transformerless, there is no voltage spike on the switches when they turn off. Furthermore, inasmuch as the input current of the presented topology is continuous, it can be employed in renewable energy applications. The operating principle and steady-state analysis of the introduced converter are investigated. Finally, the performance of the introduced converter as well as theoretical analysis is confirmed with the help of simulation and experimental results.

Keywords—SEPIC-based converter; transformerless converter; high step-up voltage

I.INTRODUCTION

In recent years, high gain converters connected between low DC input voltage and the other side, have become commonly used in various applications. Their most important applications are in renewable energy, namely photovoltaic (PV) and wind power systems, energy storage systems, uninterruptible power supplies (UPS), and fuel cells energy conversion systems, which have a low DC output voltage [1, 2]. On the other hand, most loads that are supplied by renewable energy need a high voltage level. For this purpose, the use of high step-up gain converters has expanded to enhance the level of voltage and to regulate it. In addition, a high gain converter with continuous input current is more ideal to track the maximum power point of PV panels inasmuch as the dynamic of the control system decreases with a DC-DC converter with a discontinuous input current. Therefore, the DC-DC converters which are used in renewable energy must benefit from high step-up voltage gain as well as continuous input current [3, 4].The traditional buck-boost topology is not suitable because of the fact that it has a discontinuous input current and low voltage gain. Moreover, to enhance the output voltage level in the conventional boost converter, it is used in a high duty ratio. Since the input voltage of the step-up converter is low and it takes high input current, it diminishes the converter efficiency noticeably. Furthermore, because of the fact that voltage stress on the active switch and the output voltage are equal in the boost converter, high output voltage requires a high voltage switch which has a higher $RDS.on$. This effect causes the reverse- recovery problem in the output diode and the increase of the conduction losses [5].Lately, different techniques are being used to get a high voltage gain without the aforementioned problems. Examplesnclude isolated high gain converters, non–isolated converters, the latter of which are divided into coupled and non-coupled inductor converters. Isolated DC-DC converters and coupled inductor converters suffer from leakage inductance since it generates voltage spike across the switches when they turn off [6]. Hence, in these converters, in order to improve the efficiency, a clamping circuit should be used to absorb the energy of the leakage inductance during the turn off process [7]. However, a clamping circuit comes with an increase in complexity and cost. The non-coupled inductor converters usually use cascade converters techniques [3], voltage- multiplier techniques [1], and voltage lift techniques [5] to obtain a high voltage gain with a high efficiency. Nevertheless, it is necessary to use many components, especially in cascade techniques, in order to provide several voltage multiplier stages, which surges complexity and cost of the converter.

Recently, special attention has been focused on the SEPIC converter in industrial applications because of its unique features. Therefore, numerous research has been done on this converter, especially its voltage gain. An isolated SEPIC converter is presented in [8], and also coupled inductor converters based on SEPIC converter are introduced in [9], the majority of which suffer from stress voltage across the active switch because of the leakage inductance issue. Hence, some transformerless SEPIC-based converters have been introduced in [10, 11]. Although these converters do not use any coupled inductor, they cannot provide a high voltage gain. Recently, a transformerless SEPIC converter shown in Fig. 1(a) is introduced in [12] to provide a high voltage gain. In spite of the fact that this topology provides a high voltage gain, it suffers from high input current ripple and high conduction losses in the switches. In this work, a novel high gain SEPIC converter is proposed to enhance the converter presented in [12]. The proposed converter is simple since a simple auxiliary circuit is only added to the converter in [12]. The proposed DC-DC converter provides some specific benefits, which are presented as follows

II. OPERATING PRINCIPLE OF THE PROPOSED CONVERTER

Designing a renewable energy-based SEPIC converter requires a thorough understanding of the principles of power electronics and control theory. This section will provide a detailed overview of the steps involved in designing a SEPIC converter for use with renewable energy sources such as solar panels or wind turbines

Define the Specifications:he first step in designing a SEPIC converter is to define the specifications. This includes the input voltage range, output voltage and current, and efficiency requirements. These specifications will dictate the choice of components and the design of the circuit.For example, if the input voltage range is between 12-24V, and the output voltage is 5V, the converter must be designed to step down the voltage. Additionally, the output current requirement will determine the choice of inductor and capacitor values. The efficiency requirement will also play a role in component selection, as higher efficiency components will result in a more efficient converter.

Choose the Components:Based on the specifications, the components for the SEPIC converter can be chosen. This includes the inductor, capacitors, diodes, and switches. The components should be selected based on their ratings and specifications, such as current and voltage ratings, frequency response, and ESR (Equivalent Series Resistance).The inductor is one of the most critical components of the SEPIC converter, as it stores and releases energy to maintain the output voltage. The choice of inductor depends on the input and output voltage, as well as the maximum current that will flow through it.The capacitors are used to filter the output voltage and reduce ripple. The choice of capacitors depends on the output voltage and current requirements, as well as the frequency of operation. The diodes and switches are used to control the flow of current through the circuit. The diodes should be chosen based on their reverse recovery time, while the switches should be chosen based on their current and voltage ratings.

Design the Circuit: Using the chosen components, the circuit for the SEPIC converter can be designed. The circuit should be designed to meet the specifications, and should include the control circuitry for regulating the output voltage.

The SEPIC converter uses a buck-boost topology to regulate the output voltage. This topology allows the converter to regulate the output voltage even when the input voltage varies. The basic SEPIC converter circuit consists of an inductor, two capacitors, two diodes, and a switch.The control circuitry for the SEPIC converter typically uses a feedback loop to regulate the output voltage. This feedback loop compares the output voltage to a reference voltage and adjusts the duty cycle of the switch to maintain the desired output voltage.

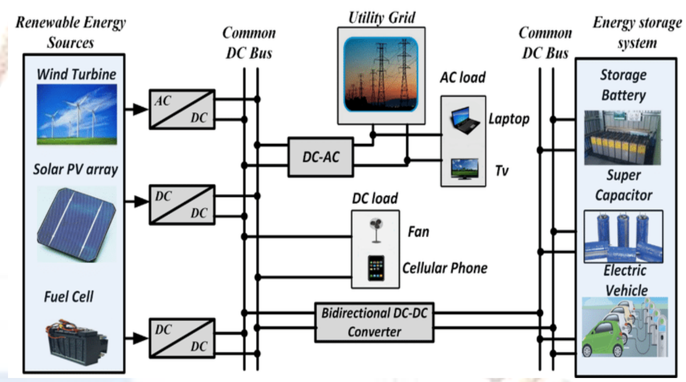

Fig 1 Working Connection

Simulate the Circuit: Once the circuit is designed, it should be simulated using software such as MATLAB/Simulink to verify its performance. The simulation should include the input voltage, load, and control circuitry.The simulation should also include any non-idealities in the components, such as the ESR of the capacitors and the reverse recovery time of the diodes. This will ensure that the simulation accurately reflects the performance of the actual circuit.

Optimize the Design: Based on the simulation results, the design of the SEPIC converter can be optimized to improve its performance. This may involve adjusting the values of the components, changing the control strategy, or using more efficient components. The optimization process should be iterative, with the circuit being simulated and modified until it meets the desired specifications. This may involve using different control strategies or topology variations, such as the Cuk or Zeta converters. Implement and Test the Circuit: Once the design is optimized, the SEPIC converter can be implemented and tested in a real-world application. This may involve building a prototype circuit and testing it with a renewable energy source and load. Circuit should be monitored to ensure that it is operating within the specified range of input and output voltages and currents. The efficiency of the converter should also be measured to ensure that it is meeting the efficiency requirement. If any issues arise during testing, such as voltage spikes or current surges, the circuit may need to be modified and retested. This process may involve adjusting the values of the components or changing the control strategy.

Consider Environmental Factors: When designing a SEPIC converter for use with renewable energy sources, it is important to consider environmental factors such as temperature and humidity. These factors can affect the performance of the components and the overall efficiency of the circuit. For example, high temperatures can cause the inductor to overheat and reduce its efficiency.

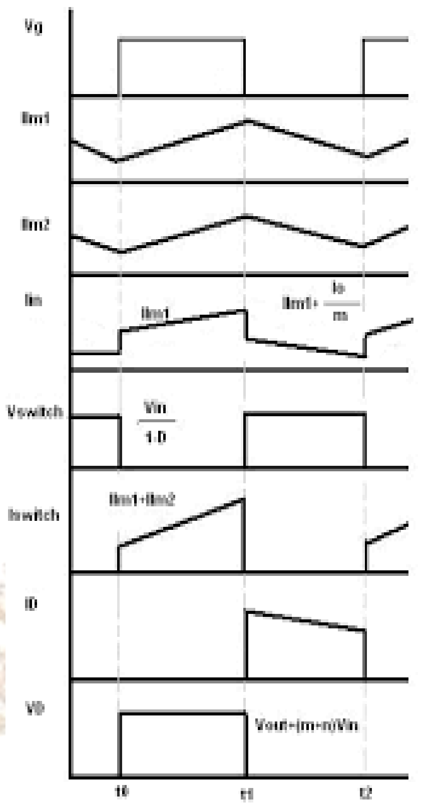

Fig 2 Waveform

To mitigate this issue, the inductor may need to be designed with a higher current rating or a larger physical size. Similarly, high humidity can cause the capacitors to degrade and reduce their performance. Choosing high-quality, moisture-resistant capacitors can help prevent this issue. Conclusion: Designing a renewable energy-based SEPIC converter requires careful consideration of the specifications, choice of components, circuit design, simulation, optimization, implementation, and testing. By following these steps and considering environmental factors, it is possible to design a SEPIC converter that meets the desired specifications and operates efficiently with renewable energy sources.by keeping the same IDovertime.

This paper presents a machine learning-based approach for detecting improper dress code in college entrance settings using the MobileNetV2 algorithm and transfer learning. The proposed system employs a moveable bot equipped with a sound indication system to alert individuals who may be violating dress code policies. Transfer learning is utilized to leverage pre-trained weights from the MobileNetV2 network, allowing for improved accuracy and efficiency of the detection process.

Our results demonstrate that the proposed system can achieve high accuracy in detecting improper dress code in real-time, indicating the potential for practical use in college entrance settings.

Overall, our approach represents an innovative application of machine learning techniques and has the potential to improve compliance with dress code policies and enhance the professionalism of college entrance settings.

III. CONCEPT

Renewable energy-based SEPIC converter is an important concept in the field of power electronics. It is used to convert energy from renewable sources such as solar panels and wind turbines into a usable form of energy that can be utilized by various electrical devices. The SEPIC topology is a versatile converter that is widely used in applications where the input voltage may vary widely, such as renewable energy systems.

The concept of designing a renewable energy-based SEPIC converter involves several important steps. The first step is to define the specifications of the converter. This includes determining the desired output voltage and current, as well as the input voltage range and the efficiency of the converter.

The next step is to select the appropriate components for the converter. This includes selecting the inductor, capacitors, diodes, and other components that will be used in the circuit. The choice of components will depend on the specifications of the converter as well as the characteristics of the renewable energy source being used.

Once the components have been selected, the next step is to design the circuit. This involves designing the control strategy and determining the placement of the components in the circuit. The control strategy is critical to the performance of the converter, and it must be designed carefully to ensure that the converter operates efficiently and reliably.

After the circuit has been designed, the next step is to simulate the circuit. This involves using software to simulate the operation of the circuit under different conditions. Simulation is an important step in the design process because it allows designers to test the performance of the circuit before it is built.

Once the circuit has been simulated and optimized, the next step is to implement the circuit. This involves building the circuit using the selected components and testing it to ensure that it operates as expected. The implementation phase may involve making adjustments to the circuit based on the results of testing.

The final step in the process is to test the circuit. This involves measuring the input and output voltages and currents of the circuit and ensuring that it is operating within the specified range. The efficiency of the converter is also measured to ensure that it is meeting the efficiency requirement.

Designing a renewable energy-based SEPIC converter requires a thorough understanding of power electronics and control theory. It is a complex process that involves several important steps, including defining the specifications of the converter, selecting the appropriate components, designing the circuit, simulating the circuit, implementing the circuit, and testing the circuit. By following these steps, it is possible to design a SEPIC converter that meets the desired specifications and operates efficiently with renewable energy sources.

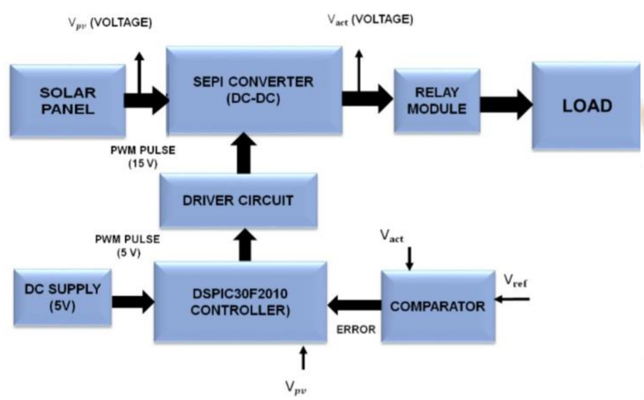

Fig 3 Block diagram

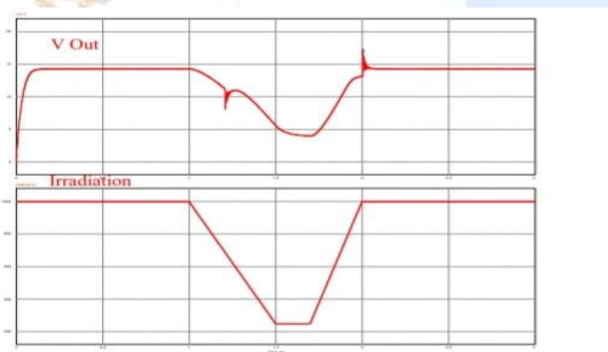

Fig 4 Graph

IV. CONCLUSION

In conclusion, the concept of designing a renewable energy-based SEPIC converter is an important area of research in the field of power electronics. Renewable energy sources such as solar panels and wind turbines are becoming increasingly popular due to the need for sustainable energy solutions. The SEPIC topology is a versatile converter that is widely used in applications where the input voltage may vary widely, such as renewable energy systems.

The process of designing a renewable energy-based SEPIC converter involves several important steps, including defining the specifications of the converter, selecting the appropriate components, designing the circuit, simulating the circuit, implementing the circuit, and testing the circuit. Each step is critical to the overall success of the project, and it is important to follow these steps carefully to ensure that the converter meets the desired specifications and operates efficiently with renewable energy sources.

Defining the specifications of the converter is the first step in the design process. This step involves determining the desired output voltage and current, as well as the input voltage range and the efficiency of the converter. It is important to carefully consider the specifications of the converter to ensure that it meets the requirements of the application.

The next step is to select the appropriate components for the converter. This step involves selecting the inductor, capacitors, diodes, and other components that will be used in the circuit. The choice of components will depend on the specifications of the converter as well as the characteristics of the renewable energy source being used.

Once the components have been selected, the next step is to design the circuit. This involves designing the control strategy and determining the placement of the components in the circuit. The control strategy is critical to the performance of the converter, and it must be designed carefully to ensure that the converter operates efficiently and reliably.

After the circuit has been designed, the next step is to simulate the circuit. This step involves using software to simulate the operation of the circuit under different conditions. Simulation is an important step in the design process because it allows designers to test the performance of the circuit before it is built.

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of testing.

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Designing a renewable energy-based SEPIC converter is a complex process that requires a thorough understanding of power electronics and control theory. However, it is an important area of research that has the potential to contribute to the development of sustainable energy solutions. Renewable energy-based SEPIC converters can be used to convert energy from renewable sources such as solar panels and wind turbines into a usable form of energy that can be utilized by various electrical devices.

In summary, the concept of designing a renewable energy-based SEPIC converter is an important area of research that has the potential to contribute to the development of sustainable energy solutions. The process of designing a renewable energy-based SEPIC converter involves several important steps, including defining the specifications of the converter, selecting the appropriate components, designing the circuit, simulating the circuit, implementing the circuit, and testing the circuit. By following these steps carefully, it is possible to design a SEPIC converter that meets the desired specifications and operates efficiently with renewable energy sources.

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