IMPLEMENTATION OF PV BASED BIDIRECTIONAL DC TO DC CONVERTER USING FUZZY LOGIC CONTROLLER FOR ELECTRIC VEHICLE APPLICATION

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ABSTRACT

In this project explains how the bidirectional converter can be used to charge electric vehicles. We used a bidirectional dc to dc converter to design the electric vehicles charging system. A bidirectional half-bridge DC/DC converter is used in hybrid electric vehicles to provide the main energy storage system and electric traction motor are interface between the power electronics. Battery unit and an ultra-capacitor unit are one of the part of a hybrid energy storage device. The dc links are connected to the battery and ultracapacitor storage unit. It was decided to use a parallel dc-linked multi-input converter with a half-bridge bidirectional DC/DC cell topology. Although the electrical architecture of an Electric Vehicle (EV) is standard the construction of its various building blocks is an open problem whose solution could dramatically enhance the vehicle's overall performance.

Keywords: Bidirectional DC-DC, Fuzzy Logic, Solar Panel.

1. INTRODUCTION

The developing concern on a post-petroleum future, environmental sustainability, energy efficiency, and global warming have driven governments, businesses, and individual to invest in an emerging market where renewable energy tend to be one of the more solid foundations. The electric vehicle (EV) has become a common topic of discussion and a sought-after research topic, they discussed the basics of the EV method[1]. Electric vehicles, on the other hand, are not yet a mature technology, and significant contributions are anticipated, for example, in electrical architecture regulation. The design and control of an electric vehicle traction system has been described on this paper.

The electric vehicle has literally with a battery, PV array, fuel cells, or a generator from this source we convert fuel to electricity, or it can be powered by electricity from energy storage bunk in the collected system. Electric vehicles include road and rail vehicles and sea boats, electric planes, and electric satellite station. An electric vehicle is commonly referred to as an EV. The DC line voltage is greater than the battery voltage, a plug-in electric vehicle's traction system helps in the analysis the battery, a bidirectional converter, and motor in the energy storage system[2]. In this paper is planned, modeled, and simulating the traction system using the aforementioned parts as well as a mechanical load. Because of the load, the engine is forced to run the system as a motor or as a generator. The Microgrid system is used to charging electric vehicles(EV) in remote areas. The separate station is used to charging the EVs[3]. The implementation of PV arrays and mini power storage systems in the EV using renewable energy efficiently. The discussion of the Super-Lift Converter SLC circuit is to give the high voltage to the DC link[4]. The replacement of SLC by the bidirectional converter to change the simulated outputs. In the DC-DC converter, some switching losses occur in the simulated output and only one mode operation is discussed [5]. The Bidirectional converter is implemented in this paper for the advanced two modes of operation. The IGBT switches-based converter is used to grid, PV to electric vehicle(EV) charging system[6]. Some losses occur in between the switches, the bidirectional converter is used to reduce the losses. The MPPT tracking system and converters are studied and analyzed the system to track the simulated results [7]. The purpose of the operating in three different modes are available in SVP-DSTSTCOM, they are (1) Surplus Power Mode (SPM), (2) Balanced Power Mode (BPM), (3) Deficit Power Mode (DPM), helps to store the energy in the battery[8].The state variable ripple functions the component values are displayed, use the small ripple approximation [9]. The Bidirectional dc-dc
converter is used simulating the output is get some deviation and more time take the feedback, So implement the Fuzzy logic rule to get output in efficiently[10]. Basic information is obtained from these converters, which contributes to the creation of interleaved and bidirectional converters. One of the most common applications, such as a battery charging device using solar energy for domestic (or) commercial purposes, produces the desired output voltages. But the operating efficiencies are low. Furthermore, switching losses are high, making the device less efficient. This paper aims to identify the best EV application for the future. Traditional power generation methods focused on coal and other fossil fuels have problems like resource depletion, emissions, and global warming. The energy comes from the program that we used. We recover energy by the use of a bidirectional converter in this project, and we make effective use of the energy.

II. EXISTING SYSTEM
In the existing method, a half-bridge DC-DC converter has been installed. The existing system has a lot of switching stress. It has been implemented as a dc-dc boost converter. DC to DC converters dents to transfer power in single direction from the dc sources. The converters are the one of the application of the EV energy systems. In electric vehicles, the energy storage system is connected DC to DC converters through the DC line. In electric vehicles, the bidirectional converter can transfer energy from the battery to the motor through a dc bus. When the converter will be boost the voltage, at the time motor in the running mode with the battery on the low power and the dc bus on the high power. When the mechanical to electrical energy operation mode, the converter help to stored energy in battery.

The speed of the DC motor is directly proportional to the DC link voltage applied, variable DC link voltage is used to regulate the speed. Centered on the principle of the steady DC connection voltage and PWM for speed modulation, The proposed a buck-boost converter feeding a DC motor with high switching losses.

![Figure 1 Existing system Block Diagram](image)

In the existing system, renewable energy solar is used during the low sunlight or night time we cannot use solar energy so we can use an alternative source like a battery can be used. And the dc to dc converter can get power from the source and convert the required amount of energy to run the motor. Arduino is used to interfacing the operation of PV and battery and also the load of the motor to display the LCD. A buck-boost converter configuration is the best of the bridgeless converter topology high amount of DC-link voltage controller (i.e. bucking and boosting mode) needed in this application. Bridgeless buck and raise converters have been demonstrated by both Jang and Huber. These can be provided voltage bucking or voltage boosting, limiting the operating range of the DC connection voltage controller.
In contrast to brushless DC motors[21][22], DC motors are better because they can only operate small applications such as water pumps. Electric vehicles also use induction motors and switch reluctance motors. Permanent Magnet Brushless DC Motors (PMDCM) are used only the small power applications only, because of their output, speed, energy density, torque, inertia ratio, these are higher and low maintenance, and the range of speed control[23][24]. The stator of a BLDC motor has three-phase distributed windings, and the rotor has a permanent magnet. That is why, due to the high performance of the operation, increased efficiency, and high power gain in output, we have switched to DC motors.

III. PROPOSED SYSTEM

The proposed device is a bidirectional, independent DC-DC converter. A dual full-bridge topology is used to achieve the power ranking. When using a bidirectional DC to DC converter in the electric traction drive between the Power Electronic Interface (PEI) and the Energy Storage System (ESS), it's critical to specify the electric tracking system's. These specifications include the degree of the vehicle's hybridization, as well as the drive rail configuration, electric AC drive system, and DC to DC PEI configuration. In this paper, the energy for electric vehicle charging comes from two sources: battery and solar, as well as a bidirectional DC to DC converter that converts mechanical energy to electrical energy, allowing the energy to be used more effectively. The bidirectional DC to DC converters convert power between charging and discharging operations.

The DC motor is powered by solar or the main battery, and if there is a problem with the system, the bidirectional DC to DC converter automatically connects with second battery to the device. We integrate the system into an existing system to make the most of the available power. The elimination of the dc-dc converter stage results in a reduction in one power stage, reduced circuit complexity, and lower converter costs as compared to other converters, all without compromising the PV array's output. A photovoltaic system's solar panel, also known as a solar module, is a variable. They're made up of a board with a collection of photovoltaic cells placed on it. They are combined to create power and come in a variety of rectangular shapes. The power from the solar panel is dc, which is converted to direct current for use in EV using a bidirectional DC to DC converter. The bidirectional converter transfers energy from a battery to electric vehicles and the other way around. The interfaces between Vehicle-to-Battery (V-2-B) and Battery-to-Vehicle (B-2-V) are typically built using load balancing and active power management. The LCD is located here for monitoring the system's status.
IV. HARDWARE DESCRIPTION

In this system, we archive the full amount of renewable energy. When we get more amount of sunlight the PV cell produces a high amount of energy, we stored the excess energy in the main battery. The whole operation occurs through a bidirectional dc to dc converter. The motor energy change to electrical energy in the reverse process, then we stored our energy in the battery/super capacitor. The stored energy is used when the PV will produce a low amount of energy. As compared to electrolytic capacitors, a supercapacitor can hold a significant amount of power, typically 10 to 100 times more power per unit strength or volume. The supercapacitor, also known as an ultracapacitor or a double-layer electrolytic capacitor, is a type of capacitor with two layers. Arduino is a forum for creating electronic projects that are open source. Arduino consists of programed circuit boards (also known as microcontrollers) and software, known as an IDE (Integrated Development Environment), that runs on the system and allows you to write and upload in system code to the physical board. The total system is renewable energy only, it helps our future.

4.1 BIDIRECTIONAL DC-DC CONVERTER

For controlling electric vehicle charging applications, a bidirectional dc-dc converter is used. Electricity is used as the primary fuel in hybrid and plug-in electric vehicles, or to increase the performance of traditional vehicle designs. HEVs are propelled by a traditional or alternative-fuel compressing CI engine and a battery power electric motor. Small amount of emissions and strong fuel economy are combined within the power and level of conventional vehicle in HEVs. PHEVs are powered by a combination of conventional fuels and electrical energy stored in the battery. This type of converter nowadays is especially utilized in electric Vehicles. A Half bridge DC to DC Converter is another name for it. When the buck and boost converters are connected in opposite across each other, the resulting circuit has the same basic structural as a buck - boost converter, but with the added feature of bidirectional power flow. This is known as a bidirectional DC-DC converter. It can be used in both directions.

![Bidirectional DC-DC Converter](image)

Figure 3 Bidirectional DC-DC Converter

4.2 BOOST CONVERTER

The proposed of the converter is a bidirectional boost converter with an output filter for the converter, since the output filter decreases the size of the supercapacitor for both the operation charging and discharging. To continuously the conduction mode is operating in the output. The converter has been expressed in state-space during Ton.

\[ X(t) = A_{ON}X(t) + B_{ON} \quad (1) \]
V. SOFTWARE DESCRIPTION

MATLAB (matrix laboratory) is the number language and fourth-generation programming language. Matrix manipulations, function and data plotting, algorithm implementation, user interfacing design, and interact to programs languages are including C, C++, Java, and Fortran are all possible with MATLAB, which was created by Math Works. Little's specialty, control engineering, was the first to introduce MATLAB, but it soon spread to a variety of other fields. It's now widely used in education, especially in the thought of linear algebra and number system analysis, as well as among image processing researchers. The MATLAB framework is based on the MATLAB programming language. The most straightforward way to run MATLAB coding is to give into the normal Window, which is one of the MATLAB Desktop's components. When code is inserted in the Command Window the MATLAB interface to program. A variety of features in MATLAB allow you to log and share your work. Your MATLAB code can be interact to the other languages and applications, and your MATLAB algorithms and applications can be distributed.

5.1 FUZZY LOGIC

Fuzzy logic is a form of logic in which there are several truths or false logic values that range from 0 to 1. The truth values of variables are either 0 or 1. This differs from Boolean logic. However, in the case of fuzzy logic, there are several levels between 0 and 1, including fully true, completely false, partially true, partially false, and partially true, partially false. Specific functions are in charge of these.

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Table 1 RULE BASE OF FLC
The flexibility of the main concepts is threefold. That's the right error, error range, and output. Each has triangular membership functions. This is shown in the fig tree 8 variables are expressed in a variety of languages from very good (PB), very little (PS), zero (Z). And from the negative side the biggest negative (NB), the negative small (NS), and zero. (Z) the above rules are set based on system performance. According to the input, the rules of the opposite concept of the PWM control function cycle are adjusted. We can settle the desired number of five membership functions rule numbers are 25 errors and error modification (FLC input).

V. RESULTS

The aim of the Simulink circuit is used to analysis the system. The battery regulation simulation is carried out using Simulink is a programming language. The slipping, the generator, and the dc to dc converter. A battery, the controller mode, and the power required are all modeled in part of the Simulink circuit. The worth of the sliding surface's constants has been tweaked experimentally.

The X-axis is representing the time in a sec, and the Y-axis is representing the battery current, voltage, and soc %. The soc is helped to analyze the battery discharging status.
During temporary operation such as start up, brake, and speed reversal, excess current is taken from the source. The excess current taken from the source will overload it or trigger a voltage drop. As a consequence, the source and motor currents are limited by the power modulator. It detects specific drive parameters such as motor current, voltage, and power. It is primarily needed for either safety or closed-loop activity. The Supercapacitor is used to store our get back energy. The waveform gets the discharging time response only. The X-axis is representing the time in a sec, and the Y-axis is representing the supercapacitor current, voltage, and soc %. The soc % value gets down when we use stored power.

The output waveform of battery voltage and current, as well as the power needed for the device, are shown in this simulation. The Supercapacitor response was also measured, as well as the supercapacitor voltage, current, and device on chip (soc percent). To simplify the analysis, the waveforms of the battery voltage, current, and device on-chip percent are used. The soc percent will return from high to low after the device has been running for a while, as shown by the waveform in the figure.
This waveform is helpful to analyze the power required to run over the system. The X-axis is representing the time in a sec, and the Y-axis is representing the power in watts and the requirement of power.

**Figure 11 Battery and Super capacitor Output**

**VII. CONCLUSION**

The implementation of a bidirectional converter for an electric vehicle charging system is defined in this project. For charging and discharging, we engineered an electric vehicle charging system with a bidirectional dc-dc converter. In this paper using bidirectional dc to dc converter is drive the dc motor devoted to electric vehicles application. The controller allows both motoring and regenerating power efficiently. The Fuzzy logic control network is simple, and its auto-tuning function makes it simple to regulate or control the flow of energy from the battery to the vehicle, and vice versa. In hybrid electric vehicles, a bidirectional half-bridge DC/DC converter interface connects the main energy storage mechanism to the electric traction motor. A hybrid energy storage system is being considered that includes a battery unit and an ultra-capacitor pack. Sequence dc-linked multi-input converter with a half-bridge bidirectional DC/DC cell topology was selected to connect the battery and supercapacitor unit to the dc connection.

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