

BATTERY CHARGER FOR ELECTRIC VEHICLES THAT RELY ON PV ARRAYS TO BE LOCATED OFF THE VEHICLE

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ABSTRACT:

The development of electric vehicles (EVs) has been a major driver of the automotive market's expansion during the last 10 years. One of the major factors affecting the growth of electric cars is the infrastructure for battery charging. When an electric car's battery is charged via the power grid, the system has to use more energy.

In light of this, the researchers' proposal calls for an off-board EV battery charging system that uses a photovoltaic (PV) array-based controller. To ensure that the electric vehicle's battery is continuously charged, a secondary battery bank is used in addition to the PV array.

The proposed system's sepic converter and three-phase bidirectional DC-DC converter enable night or day charging of the EV battery.

Both the backup battery and the EV battery are charged during the warmest portion of the day. The backup battery helps recharge the EV battery at night or on overcast days. This is the result of a Simulink simulation run in MATLAB using the suggested charge system as its basis.

I.INTRODUCTION

Concerns about the environment are caused by the ever-increasing impact of greenhouse gases produced by traditional internal combustion engines. This opened the way for the explosion in the production of pollution-free electric cars (EVs) in the automotive sector [1–3]. However, charging electric vehicle batteries via the utility grid raises the load demand on the grid. This, in turn, results in higher electricity bills for owners of electric vehicles, which compels such individuals to seek for other sources of energy [4, 5]. It is possible to utilise renewable energy sources (RESs), which do not produce pollution and do not run out, to charge the battery of an electric vehicle (EV). Therefore, electric vehicles powered by renewable energy sources may be referred to as "green transportation" [6]. Solar power is one of the potential renewable energy sources that may be readily harnessed to use its energy to charge the batteries of electric vehicles [7, 8].

As a result, the electricity from the PV array is what is utilised to charge the EV battery in the system that is being suggested, and this is done with the assistance of various power converter topologies. As a result of its high power density, high efficiency, low weight, and small size [9, 10], lithium ion batteries are

employed extensively in electric vehicles. Additionally, these batteries have the ability to charge quickly and have a long lifespan while also having a low rate of self-discharge. They also have a minimal potential for explosion in the event that they are overcharged or improperly connected.

These batteries need very precise voltage regulation when they are being charged. In order to charge an electric vehicle's battery, thus, a variety of power electronic converters with a voltage controller are used. Because the PV array only produces electricity on an as-needed basis, you will require power converters in order to keep the electric vehicle's battery charged. Among the various converters, multiport converters, also known as MPCs, are the ones that are most commonly used in the on-board chargers of hybrid electric vehicles. This is because MPCs are able to interface power sources and energy storage elements, such as photovoltaic arrays, ultracapacitors, super capacitors, fuel cells, and batteries, with the loads found in EVs, which include the motor, lights, power windows and doors, radios, amplifiers, and mobile phone chargers As a result of the fact that all of the sources are housed inside the EV itself, MPCs have the disadvantage of making electric vehicles heavier, more expensive, and more

difficult to maintain. In these converter-based EV battery charging systems, the complexity of controller implementation also rises [11–13]. Therefore, in this work, an off-board charger is presented, in which the EV battery is housed inside the vehicle unit, and the PV array and backup battery bank are housed within the charging station or parking station respectively. In the research that has been done [14–16], several converter topologies for off-board charging systems have been presented.

It is the versatility of the sepic converter to function in both boost and buck modes that gives it the advantage over other converter topologies and makes it the top choice. It also benefits from having the same input and output voltage polarity, as well as low input current ripple and low electromagnetic interference [17, 18]. On the other hand, at times of poor solar irradiation or when the sun is not shining, it is necessary to have an extra storage battery bank in order to charge the electric vehicle's battery. The amount of solar irradiation will determine whether this backup battery bank should be discharged while it is being charged or charged while it is being discharged. Because of this, you will need a converter that can allow electricity to flow in either way [19]. Non-isolated and isolated converters are the two categories that may be used to describe the bidirectional converters. Isolation is provided by the transformer inside the isolated converters, which results in an increase in the cost, weight, and size of the converter. The primary concerns of electric vehicles are their weight and size; as a result, nonisolated bidirectional converters are best suited for this application [20–22]. Among the various nonisolated bidirectional converter topologies, the bidirectional interleaved DC–DC converter (BIDC) is preferred due to its advantages, which include improved efficiency in discontinuous conduction mode and minimal inductance value, and reduced ripple current due to multiphase interleaving technique. By using a zero voltage resonant soft switching approach, the turnoff losses may be

decreased, and the inductor current parasitic ringing effect can also be mitigated thanks to the use of a snubber capacitor that is placed across the switches. These are the additional benefits that come along with using this bidirectional converter [23–25]. The system described in [25] is an off-board EV battery charging system. When the EV is in a standstill condition, power from the PV array is passed through a bidirectional DC–DC converter to charge the EV battery. When the EV is in a running condition, the EV battery is discharged to drive the dc load in the EV. The electric vehicle's battery can only be charged while the sun is out. This is a disadvantage. The proposed charger is developed using PV array integrated with sepic converter, bidirectional DC–DC converter, and backup battery bank for the purpose of charging the battery of an electric vehicle (EV). This is done to overcome this disadvantage and to ensure that the EV battery is charged without any interruptions.

II. CONCLUSION

Developing a technique for off-site photovoltaic (PV) array battery recharge for electric vehicles is the aim of this effort. This study discusses the system's flexibility to constantly charge the EV battery under various irradiation conditions. The design and simulation of the system are done using MATLAB's Simulink platform. The results of a lab evaluation of the three modes of operation of the proposed charging system using PV modelling are shown below.

The investigation employs the RCP technique, and both the simulation and experimental settings give the dynamic reaction of the system.

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