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Grid Integrated Charging Station for Electric Vehicles

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Abstract

This paper deals with an idea of grid integrated charging station for electric vehicles with flyback converters. Keeping union budget 2021 in mind, as older engine based vehicles are going to be converted into electric vehicles, we believe that this project will provide us great exposure to the current technology, electric vehicles. This paper will help a lot in charging the electric vehicles in a simple way. This paper also proposes the idea that, whenever there are no electric vehicles for charging, then the power will be fed to the grid, similarly when there is a need for more power, then the power from the grid can be used. It helps us to design a simple and efficient charging station to charge electric vehicles. This paper deals with solar-based applications, hence it helps us to prevent the environment from pollution. It is also integrated with the grid to meet the current trend. Making use of flyback converters have many advantages like few components compared to other converters, a wide range of input voltage, single control, makes the system more simple and efficient

Key-words: Charging Station, Electric Vehicles, Grid Integration, Converters.

1. Introduction

As transportation is very essential for the growth of the country, vehicles take a greater part in that. As ordinary engine-based vehicles using petrol, diesel, emit a lot of harmful pollutants into the atmosphere. Global warming, Glacier melting, sea level rises are the consequences of the emission of toxic pollutants. In order to protect the environment, it is essential to move towards Electric vehicles. As electric vehicles are eco-friendly and also does not emit any toxic pollutants like engine-based vehicles. Batteries play an important role in this electric vehicle, as it is replacing the fuels like petrol, diesel, LPG etc. As it is inevitable to charge the batteries of the electric vehicles, to travel a long distance, charging stations becomes more important. And also the efficiency, charging time also play an important key role. This paper deals with the charging station for electric vehicles, which is simple and efficient. Our main focus is to change the converters that are already in use, to have a simple and efficient system for charging electric vehicles. As flyback converters have very few components as compared to other converters, can operate on a wide range of input voltage, can have a single control, have the capability to provide multiple units, we have chosen flyback converters. And also grid integration helps us to meet the current trend in the power system.

2. Existig System

The existing framework requires two changing dc to ac converters working at a high recurrence in order to change over the dc contribution to high recurrence ac amounts. Galvanic seclusion between the source and burden side is given by the high-recurrence transformer. Transformer additionally performs voltage coordinating between the source and the heap side since the voltage proportion between them is high. The transformer works with ac amounts and thus a dc-ac converter is needed at both the terminals. Since the framework is intended for the energy move in both the ways, dc to ac converters utilized should have the ability of bidirectional force stream. This converters likewise like the non-detached bidirectional DC-DC converters works in two methods of activity for example in buck or lift.

3. Proposed System

We propose utilizing flyback converters instead of DC-DC support converters. There are more benefits of utilizing flyback converters like can work on a wide scope of voltages, less segments, proficiency. The control procedure was created with the objective of streamlining PV power for EV

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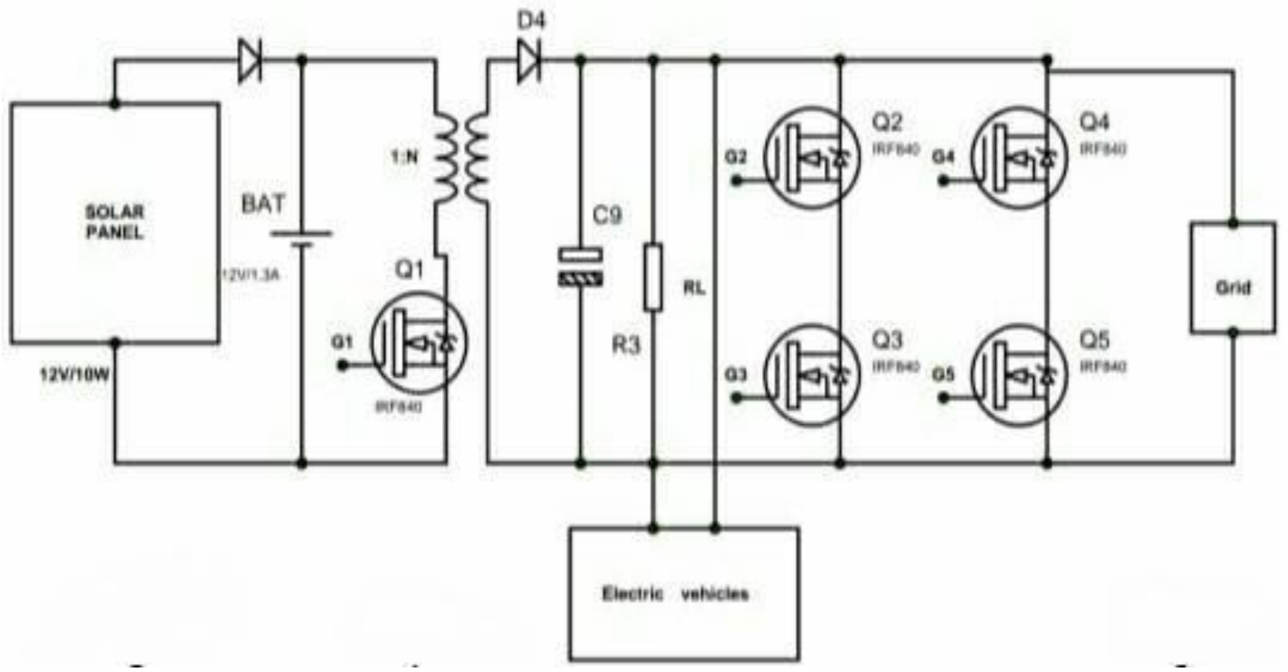
charging and expanding the trading of power with market and framework interest. At the point when an EV is associated with the battery, if accessible, the PV energy is utilized to charge the EV. In the event that more force is required, the battery or/and utility lattice will give the leftover force. On the off chance that no electric vehicle is connected, PV energy will be put away in the battery and overabundance PV force will be taken care of into the utility lattice if the battery is completely energized. At the point when the battery charge is low, matrix power is utilized during off-top hours to bring the battery condition of-charge (SOC) to an ideal level. In light of the assessment of PV power and the projections of EV charging request, the ideal battery SOC is determined.

Fig. 1 - Proposed Circuit Diagram



4. System Description

Solar energy from the sun, is collected through solar panels. The solar energy is stored in a storage device, battery, through a diode. Then, the voltage level is boosted through flyback converters, which consists of inductors and MOSFETs, through capacitors and resistors.

Thus, the electric batteries are charged. The inverters, made of MOSFETs, helps to feed the power to the grid. The flyback converters are controlled through a PIC microcontroller, which works on a +5V supply. There will be a driver circuit in between the microcontroller and the converter.

5. Hardware Components

A. Solar Panel

The solar panel is an array of PV cells. These PV cells make use of sunlight as its input and generate the direct current electricity. This solar panel helps us to generate electricity without polluting the environment, unlike non-renewable energy sources such as coal, etc. The highest efficiency of the panel is achieved through the Maximum Power Point (MPP) value of the solar panel.

B. Storage Device

In this project, we have made use of batteries to store energy. As lithium-ion batteries are rechargeable and efficient, it will be a better option in this project. As batteries consist of an anode, cathode, and electrolyte, lithium-ion batteries have mostly metal oxides as cathode, graphite, or carbon rod as anode and mainly lithium hexafluorophosphate as the electrolyte.

C. Flyback Converter

The flyback converter is a converter with the inductors, acting as a transformer. There are two states in the operation of a flyback converter. The first one is the on-state. In this state, the energy is transferred from the input voltage to the transformer. The second one is the off-state, whereas here the energy is transferred to the load. Its operation is similar to that of the actual transformer. The optocoupler has been used to have control over the flyback converters.

D. Microcontroller

The flyback converters are controlled using PIC16F877A microcontroller, as it is more viable and powerful for the application. We are using the latest Maximum Power Point Tracking algorithm, artificial fish-swarm algorithm. This algorithm helps in the solar powered charging station project in an optimum way. As the most commonly used algorithm for PV applications, the perturbation and observation method has several disadvantages.

We are moving towards, artificial fish-swarm algorithm. This algorithm has two main steps, one is to find the maximum power point of the system through perturbation observation method. In

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the next step, with a help of fish-swarm algorithm to track the global maximum power point. It helps us to have the peak voltage from the solar panel.

E. Solar Powered Charging Station

As non-renewable energy resources polluting the environment, renewable energy sources prevent the environment from harmful consequences like Global warming, Acid rain, Glacier melting, rising sea level, etc. Hence, Solar panels were used to collect the solar power. The charging system consists of a PV solar panel, battery, and converters, to charge the electric vehicles. The microcontroller is used to control the flyback converters with the driver circuit, in order to have the peak voltage through the Maximum Power Point Tracking (MPPT) algorithm. The necessary supplies of +5V for microcontroller and +12V for driver circuit is provided.

F. Grid Integration

As the power system in India is integrated with the Grid to meet the demand, our proposed idea is also interconnecting the system with the grid. In order to feed the power to the grid, when there is excess power, converting DC power into AC power is essential. Hence, it is achieved with the inverter. And also the same power can be utilized from the grid when there is less power, Hence, it is essential to convert the available AC power into DC power through a rectifier. This grid integration helps in the optimum use of power, without wasting power, Even today 30,0000 villages in India are without electricity, hence, it is vital to have optimum use of energy through this grid integration.

Fig. 2 - Prototype Photo

6. Comparison of Hardware and Software

On comparing the software simulation with the hardware output, the result shows the best match between them in all parameters like efficiency, time is taken for charging, easy control, ability to have multiple units. And also, the system can operate on a wide range of inputs, as is inevitable in solar power systems.

Fig. 3 - Simulation Circuit

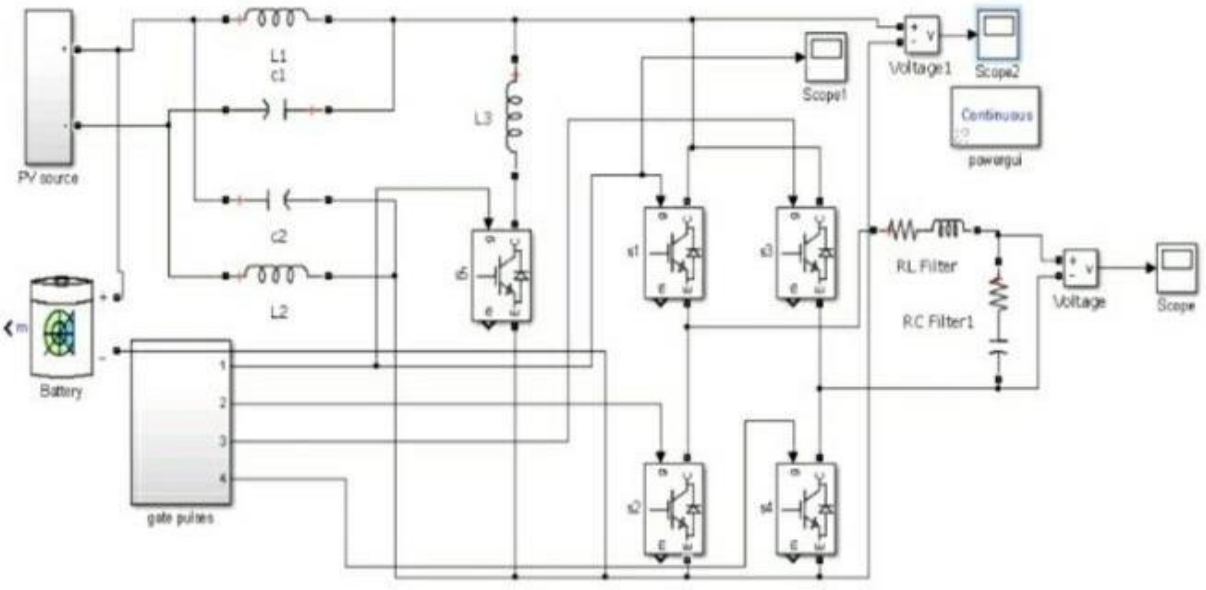

Fig. 4 - Output Voltage of Converter

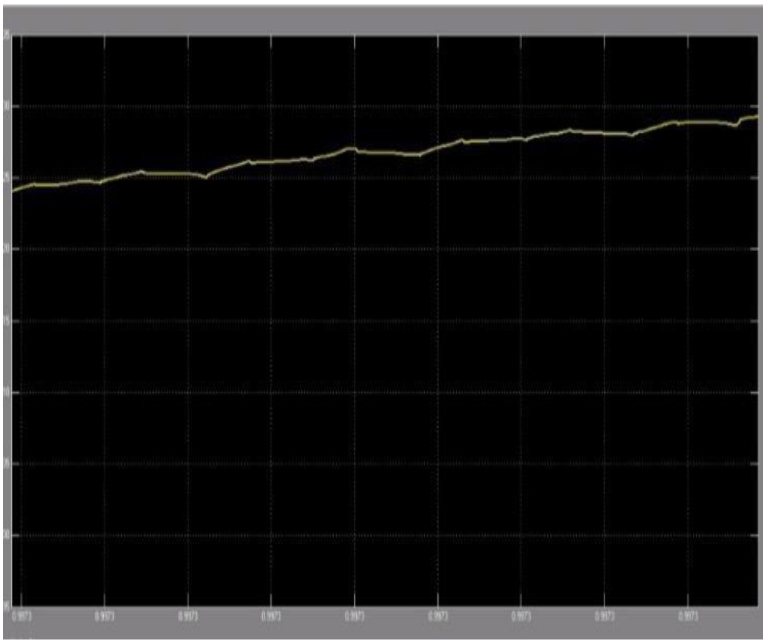

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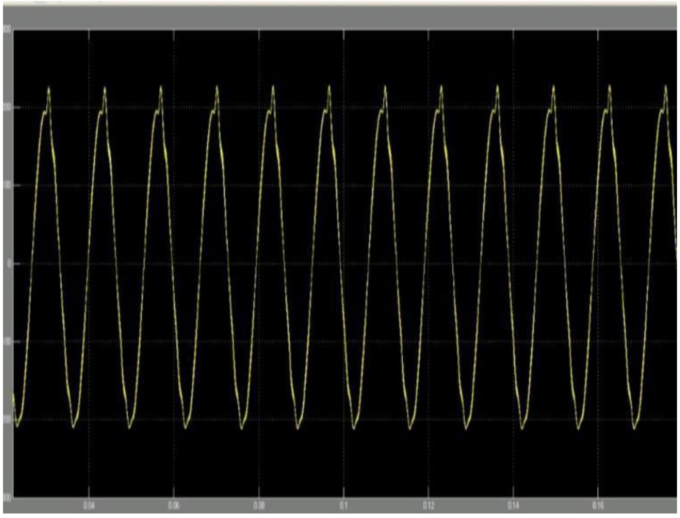
Fig. 5 - Output Voltage of Inverter



7. Conclusion

This paper proposed the idea of using flyback converters in boosting the voltage level for charging electric vehicles. And also incorporated the idea of integrating with the grid in order to have optimum use of energy. This paper proposes the idea of a simple and efficient system for charging electric vehicles. These two main ideas have been presented in this paper. Furthermore, our next motive is to have hybrid renewable energy sources for charging electric vehicles in an efficient way, by having a combination of solar, wind, geothermal, etc.

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