International Journal for Modern Trends in Science and Technology, 9(05): 30-34, 2023

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0905005
Available online at: http://www.ijmtst.com/vol9issue05.html

Implementation of Solar Based EV Charging Station

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To Cite this Article
B.Lakshmana Rao, Y.Leelaprasad, J.Chaitanya, A.Bharath Kumar, K.Sai Kumar and Dr.Ch.Ravi Kumar. Implementation of Solar Based EV Charging Station. International Journal for Modern Trends in Science and Technology 2023, 9(05), pp. 30-34. https://doi.org/10.46501/IJMTST0905005

Article Info
Received: 02 April 2023; Accepted: 26 April 2023; Published: 05 May 2023.

ABSTRACT

The fact that the running cost of Electric Vehicles (EVs) is cheaper compared to that of four-wheelers featuring an Internal Combustion Engine (ICE) has led to an increase in electric cars in India. The cost to charge an electric vehicle compared to the price of petrol or diesel is substantially low. You can reduce the electricity cost further by utilising renewable energy sources such as solar,wind and hydro. Essential technologies such as battery storage systems allow energy from renewables, like solar and wind, to be stored and released when people, communities and businesses need power. They help to increase energy system flexibility due to their unique capability to quickly absorb, hold and re-inject electricity.Solar panels generate pure D.C. electricity when exposed to sunlight. This is exactly what your batteries want.

Level I Charging: A level 1 charging equipment uses standard household power outlet with 120 V circuit. Fully charging an EV using an L1 Charger can take 8 to 12 hours or even more, depending on the EV battery type. A Level 1 charging is best done at home overnight, when the vehicle usage is the least.

Level II Charging: A level II charging describes a 240 volt AC charging and is commonly used for daily commute. An LII Charger can fully charge an EV in 4 -6 hours, depending on the EV battery type. The LII charging equipment can be found in public spaces, residential settings, and commercial areas to facilitate easy EV charging.

Level III- DC Fast Charging: A level III charging equipment charges an EV through a high-voltage DC chargers (480 V plug) and supports charging up to 500 volts. In a fast charging mode, an L3 charger can supply an EV with 80% of charge in just twenty to thirty minutes.

The proposed system consists of closed loop control of MPPT(Boost converter),2 bi- directional converters along with solar panels,EV battery and Energy storage battery. The proposed system has been implemented in Matlab/Simulink. The EV and ES battery have been charged using CC/CV method.The DC bus is maintained constant at 51V.

1. INTRODUCTION

One of the most effective ways to lessen India's reliance on fossil fuels for the powering of various types of transportation is through solar charging stations for electric automobiles. This is because electric vehicles typically consume electricity generated from fossil fuels, which is a major cause for concern.

It is essential to incorporate solar charging for electric cars and bikes as the popularity of electric vehicles rises. There are now two types of solar charging stations for electric vehicles, depending on the configuration. Continue reading to learn more about these. Charging Station for Electric Vehicles Using Solar Power Off-Grid.The charging station is not connected to

nearby utilities in this configuration. As a result, it is also known as an autonomous EV charger.

2.BLOCK DIAGRAM

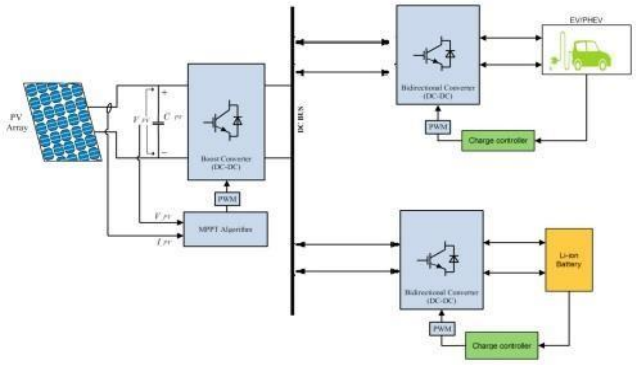

Figure 1. Block Diagram

3.DESIGN METHODOLOGY

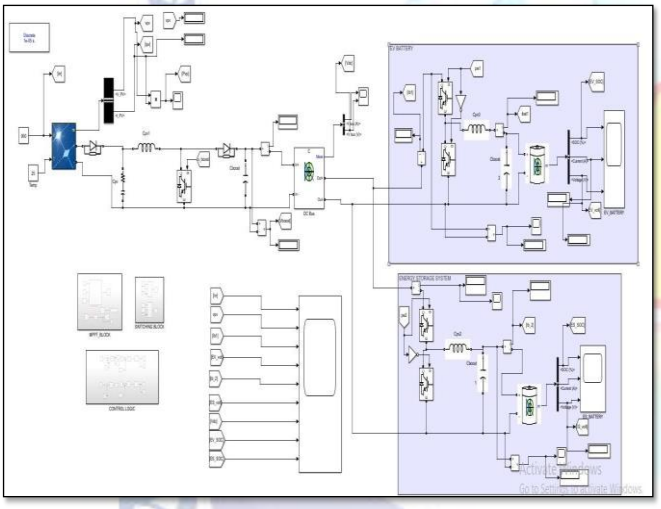

Figure 2. Circuit design

4.MODELLING PARAMETERS

PVARRAY

Fig-2.2PVARRAY

The PV Array block implements an array of photovoltaic (PV) modules. The array is built of strings of modules connected in parallel, each string consisting of modules connected in series. This block allows you to model preset PV modules from the National Renewable Energy Laboratory (NREL) System Advisor Model (2018) as well as PV modules that you define.

- Parallel strings=4
- Series connected modules per string=5
- Cells per module=20

Table 2.1 Specifications of solar panel

Module	PCS69-250P
Nominal Maximum Power at STC(Pmax)	250w
OptimumOperatingVoltage(Vop)	30.1V
OptimumoperatingCurrent(Imp)	8.30A
OpencircuitVoltage(Voc)	37.2V
ShortCircuit(Isc)	8.87A

CAPACITOR

Fig-2.3 CAPACITOR

A capacitor is a two-terminal electrical device that can store energy in the form of an electric charge. It consists of two electrical conductors that are separated by a distance. The space between the conductors may be filled by vacuum or with an insulating material known as a dielectric. A farad (F) is the standard unit of capacitance (C) in the International System of Units (SI). It indicates the ability of a substance to hold an electric charge. The value of most electrical capacitors is expressed in farads, microfarads (μF) or nanofarads (nF).

BATTERY

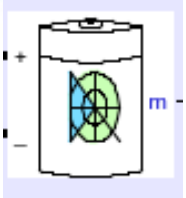

Fig-2.4 BATTERY

A **lithium-ion** or **Li-ion battery** is a type of rechargeable battery which uses the reversible reduction of lithium

ions to store energy. The anode (negative electrode) of a conventional lithium-ion cell is typically graphite made from carbon. The cathode (positive electrode) is typically a metal oxide. The electrolyte is typically a lithium salt in an organic solvent.

MPPT

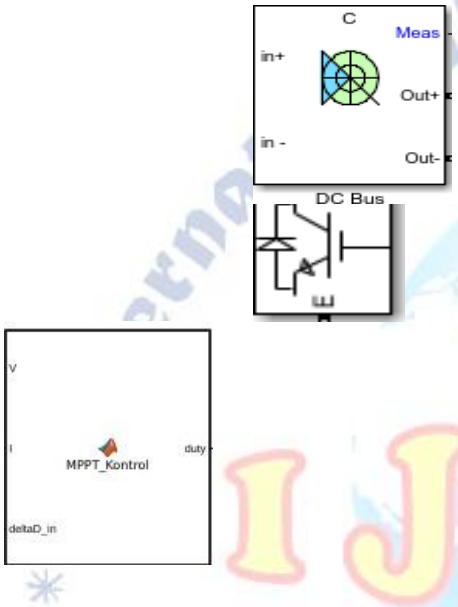

Fig-2.5MPPTBLOCK

MPPT is critical for optimizing the relationship between the solar panels and the battery bank or utility grid. It maximizes energy extraction under various conditions by keeping the array operating in the ideal operating voltage range. For solar systems with batteries, installing MPPT solar charge controllers is the way to get this done because they regulate the voltage between the solar panels and batteries. In fact, MPPT charge controllers can even help protect the batteries and promote a longer lifespan. Likewise, MPPT tracking is a feature built into grid-tied inverters, but some have more advanced characteristics than others.

PI CONTROLLER

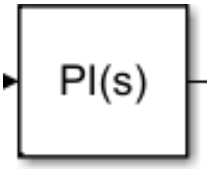

Fig-2.7: PI CONTROLLER

The Discrete PID Controller block implements a PID controller (PID, PI, PD, P only, or I only). The block is identical to the PID Controller block with the Timedomain parameter set to Discrete-time.The block output is a weighted sum of the input signal, the integral of the input signal, and the derivative of the input signal. The weights are the proportional, integral, and derivative gain parameters. A first- order pole filters the derivative action.

IGBT

Fig-2.8: IGBT

IGBT stands for insulated-gate bipolar transistor. It is a bipolar transistor with an insulated gate terminal. The IGBT combines, in a single device, a control input with a MOS structure and a bipolar power transistor that acts as an output switch. IGBTs are suitable for high-voltage, high-current applications.

DC BUS

DC BUS

DC bus is a type of circuit or protocol that serves as a common communications pathway shared by several components and which uses a direct current voltage level as a reference. It may also be used to describe a power distribution system shared by multiple components within a machine or power distribution system.

BOOST CONVERTER:

From a solar panel to a grid-tied inverter, energy is absorbed and injected through a power transfer medium called a boost converter. Four different parts an inductor, an electrical switch, a diode, and an output capacitor work together to absorb and inject energy in a boost converter Figure illustrates how a boost converter is connected. An energy absorption and injection cycle will result from this mechanism. In other words, the length of the switching on and off times determines the average output voltage. Pulse-width-modulation (PWM) switching is the process of modifying the on and off time of a switch at a constant switching frequency. The ratio of the on time to the switching time period is known as the switching duty cycle, or K.

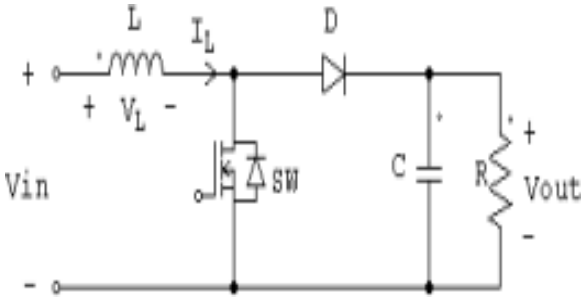

Fig-3.1: Schematic of boost converter

5.WORKING OF MODULE

Since the solar PV array is the most important part of a project, the model simply uses Photoresistor flashlights to monitor the source of the energy source, allowing for continuous power flow. Since the angle of the sun's inclination may range from 0 to 180 degrees, two sensors should be installed, one on the left and one on the right. To prevent failure of hysteresis, all DC-DC suspensions should be turned on when cell activity exceeds the planned effect. Initially, the DC-DC converter accepts DC input power and delivers the output as DC power to the next level or lower or higher depending on the output power to match the electrical power required in the module. Replacing a simple DC-DC conversion circuit will monitor the link and disconnection from the feed to the load. Provides battery with DC power supply. The output can be adjusted by properly setting the external resistance separator and running the distance from 0.8V to VIN. Input power ranges from 2.7 to 5.5V. Frequency switch set to 1.4 MHz To prevent technical problems, voltage is transmitted to Arduino analog input frequently. The meter should help keep the electricity stable stable. As an analog signal, the Arduino UNO R3 board microcontroller with 20 and six digital inputs can be used. Next, a simple Arduino system can be used to download a tracking device, distribution, and demonstration of appropriate power output. It has a wide support team, which makes it a great way to get started with technology, and the Arduino R3 is the most recent magazine. On the other hand, features such as a plug, a battery power sensor, and a car driver make it easy to avoid congestion or to transmit disruptive errors. A twopoint potentiometer of an electrical circuit in a body signal equal to the power supply obtained as a digital input in Arduino over time creates a battery power sensor. The potentiometer is designed to rise as a fixed output when the sensor detects a decrease in output, and can also decrease by increasing this output.

6.SIMULATION DIAGRAM

Case-1: SOCofEV batteryis 50%and SOCofESbatteryis 50%and simulatedfor2 seconds

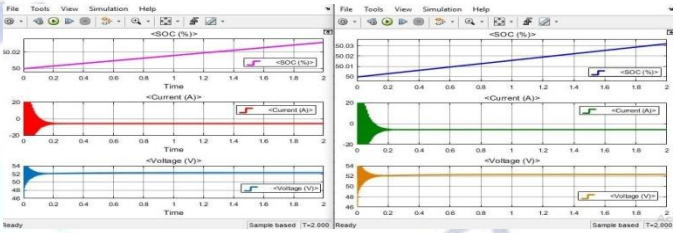

Figure 9. Simulation result 1

Case-2: SOC of EV battery is 50% and SOC of ES battery is 70% and simulated for 2 seconds.

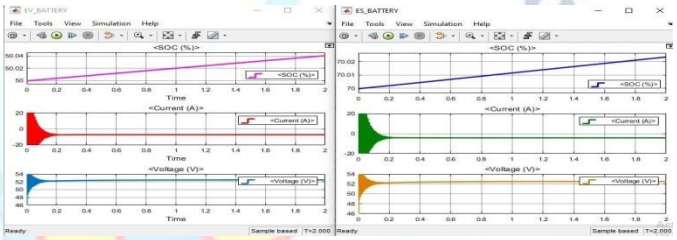

Figure 10. Simulation result 2

Case-3: SOC of EV battery is 70% and SOC of ES battery is 50% and simulated for 2 seconds.

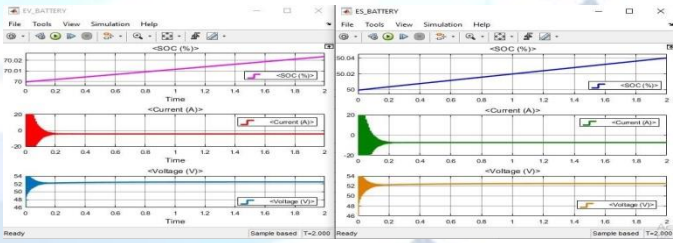

Figure 11. Simulation result 3

7. CONCLUSION

In this project we have implemented a isolated solar based charge station with energy storage.The proposed system have been simulated using matlab.The charging current and battery voltage for different soc's have been simulated. The system consists of PV panel, boost converter, ESS batteries, two DC/DC charging converters, and an EV battery. The control system consists of three controllers named the MPPT, the EV charger, and the storage converter controller. PI voltage and current controllers are adapted to control charging

of the ESS system and the EV charger as well.Constant current and constant voltage type of charging control is used for battery charging.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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