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SMART DESIGNING AND GROWTH OF SOLAR POWERED HYBRID CHARGING STATIONS FOR ELECTRIC VEHICLES

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ABSTRACT
The designing and construction of a inter crossed assertion station for electric cars are covered in this essay. The assertion station is motorized by grid power and solar energy. The overall operation of the system maximizes the use of electricity from the grid. The solution will employ solar panels for instantly charging the EV whenever solar energy is sufficient. In the absence of solar energy, the system is going to be operated by the grid. The gadget will also feed solar energy to the grid if it is accessible and there are no EVs yet linked to the charging facility but there is solar energy accessible. In this mode, the charging station acts as a solar power plant that is wired to the grid. In the present research, a powerful boost converter takes the place of the converter, which is generally used to transmit low voltage solar electricity to the grid. The equipment's pricing and dimensions are significantly reduced with this adjustment.. This study includes extensive simulation results to demonstrate the efficacy of the created hybrid charging stations.

Keywords: charge, electric vehicle, grid tie, high gain convertor, hybrid, MPPT, solar, transformer.

1. INTRODUCTION
Due to the high cost of fuel, electric vehicles are becoming more and more common in India nowadays, particularly in public transit systems. The government is supporting the utilization of electric vehicles in an effort to decrease environmental pollution and petroleum imports. One of the most important factors would be to have a suitable charging infrastructure across the country. The charging station is supercharged by grid power and solar energy. The overall operation of the system maximizes the use of electricity from the grid. The solution will employ solar panels to straightforwardly charge the EV by solar energy is accessible. In the absence of solar energy, the entire system will continue to be maintained by the grid.
Whenever there are no EVs attached to the charging station but solar energy remain accessible the system continues to supply solar energy to the grid. The charging facility will function as a solar power plant which is connected to the grid in this state of operation. Contrary to how low voltage solar electricity is typically transferred to the grid, the transformer isn't utilized in this task. An high gain boost converter is utilized instead. The equipment's pricing and dimensions are significantly reduced with this adjustment.

FIGURE OF AN EV CHARGING STATION BLOCK

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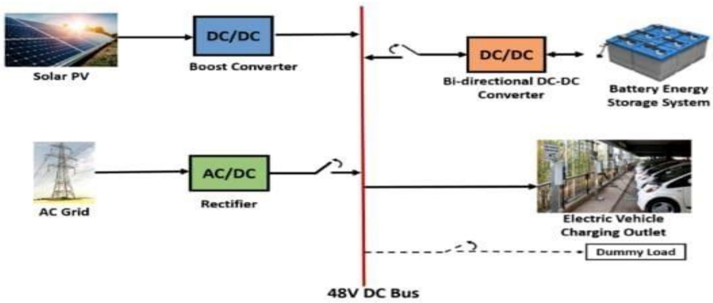

Fig.1. The PV cell Boast converter, higher gain DC-DC converter, and grid-tie inverter make up the system model.

The DCDC converter charges the EV after the PV cell transforms solar energy into electrical energy. The battery of an EV needs to be charged with a voltage of roughly 48 volts. The MPPT algorithm is utilised to maximise the power flow under this circumstance. The 48V DC bus with a 3kW power outlet for each EV is shown in the planned EV charging station's block diagram.

1. Grid with Rectifier

One of the most significant additional power needs for the charging station is the 230V AC grid, which is taken into consideration. A 230VAC source with a linear transformer is regarded as the grid in MATLAB/Simulink to step down the voltage to 48V AC. The AC voltage is transformed to a continuous 48V DC bus by means of a regulated rectifier.

2. Solar PV with Boost Converter

In MATLAB/Simulink, a 250W PV array with an open circuit voltage of 37.3V is taken into account when designing the charging station. to increase A boost converter is utilised to obtain the necessary bus voltage of 48V from the PV array voltage. With a boost converter efficiency of 80%, the solar PV is intended to charge five electric vehicles from 20% to 100% SOC over the course of three hours. As a result, the specified charging station needs a total of 24 panels.

3. BESS with Bidirectional DC-DC Converter

The extra solar energy is stored in a battery energy storage system so that it may be utilised to charge EVs at night. The functioning of the BESS's charging and discharging is managed by a bidirectional DC-DC converter. The 24V 350Ah BESS is utilised for the charging station to provide the maximum amount of energy to the connected EVs for 3 hours, taking into account charge-discharge efficiency and bidirectional converter efficiency as 80% each. Here, two different types of control mechanisms are employed, including those for power management and maintaining a steady DC bus voltage. For a boost converter, MPPT and PID control

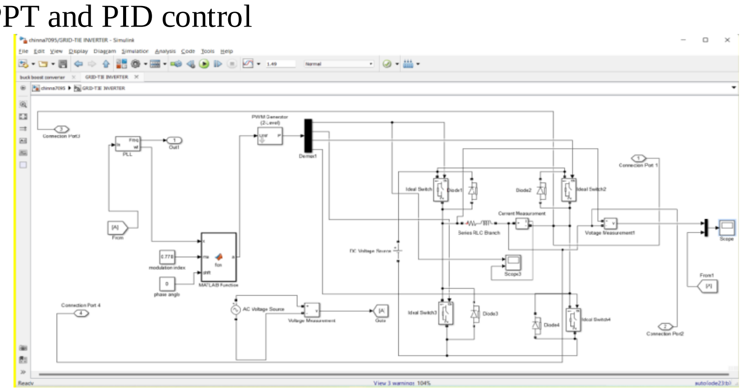

Fig.2. Grid tie inverter diagram

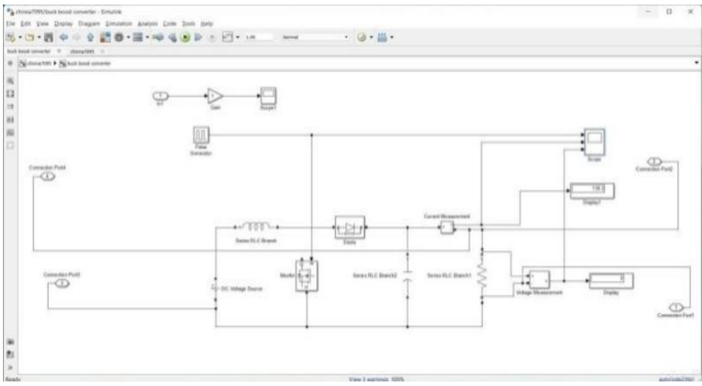

Fig.3. Buck Boost converter diagram

Solar Array

To create a single solar array, personality solar cells are stacked in a repeating matrix prototype. The vital task of transforming solar energy into electrical energy is carried out by these solar arrays. Because a capacitor has been used to connect these solar arrays across the high gain converter, the voltage across the converter's terminals is kept stable. However, the relationship between temperature and light irradiance and the current and voltage across the PV array is nonlinear. As a result, in order to operate the module at its most efficient, the voltage and current must be constantly checked.

B. Grid-tie inverter

The following block diagram illustrates the fundamental idea behind a grid-tie inverter: Grid-tie inverters operate similarly to other inverters in that they accept a DC amount as input, output an irregular amount, and additionally perform the extra task of synchronising the output with the provided reference alternating quantity. Green energy facilities that are connected to the public utility grid employ grid-tie inverters. The grid-tie inverter makes sure that the grid electricity and the converted solar power are constantly in phase. The gate pulses of the four IGBTs utilised in the H-configuration inverter model are supplied by a PWM generator. Through the use of a Phase Lock Loop (PLL) and a predetermined mathematical function, the input to the PWM generator is obtained. This model released an inverter without a transformer. The grid tie inverter's fundamental RMS output voltage is stated as V01 (RMS) = 4VS / (2) = 0.9VS.

C. High Gain Converter

Two linked inductors (T1 and T2) having turns ratios of n1:1 and n2:1, accordingly, in addition to a clamping capacitor are used in the high-gain converter to provide a higher voltage gain. The conventional near loop pulse-width modulation (PWM) control of the switch determines the output voltages of the proposed converter. The converter's architecture was built upon the principles listed below:

1. Due to the strong coupling of the associated inductors T1 and T2, there is no leaked flux in both the primary and secondary windings.

2. Both active and passive components are flawless and loss-free. 3. The output capacitor (Co) is sufficiently big to keep the output voltage (Vo) steady. Consequently, a voltage source (Vo) replaces in the corresponding circuit of the pair of output capacitance (Co) and loading impedance.

3. A constant voltage can be maintained across the clamping capacitor (Cc). The High Gain Converter's basic RMS output voltage is specified as:

$$\mathbf{VC1/VS = (1/1 - \delta) + n1\,(\delta\,/1 - \delta)\;V0/VC1 = (1/1 - \delta) + n2(\delta\,/1 - \delta)}$$

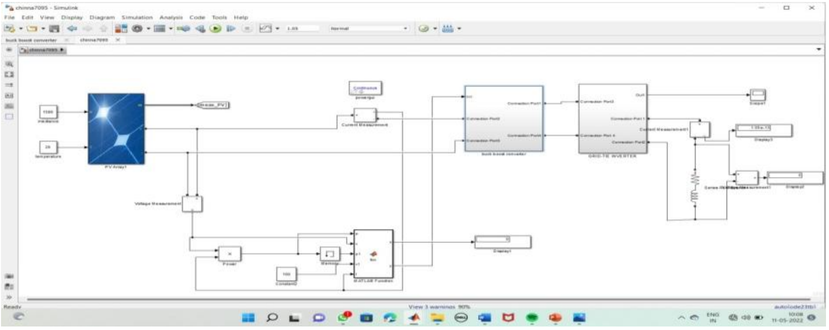

Fig.4. Electric vehicle charging station diagram

2. SIMULATION STUDY AND RESULT OF HYBRID CHARGER

The high-gain convertor, grid tie inverter, and assertion controller, for example, have each been individually created as distinct Simulink models before being merged into sub-systems to make a respective functional method. Additionally, the MPPT methodis implemented using the embedded MATLAB user-defined function block (Perturb & Observe).

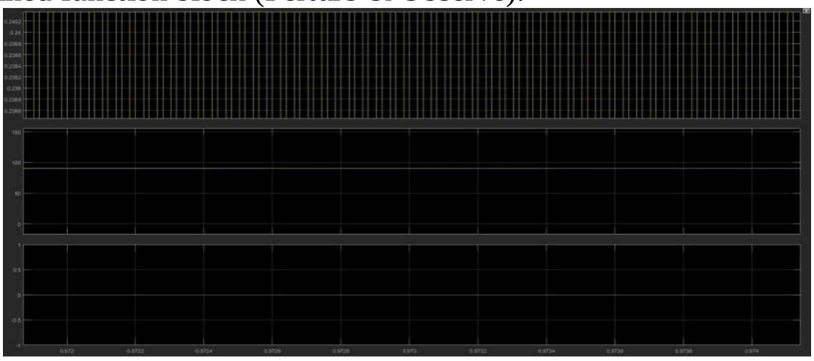

Fig.5. Buck boost converter simulation result

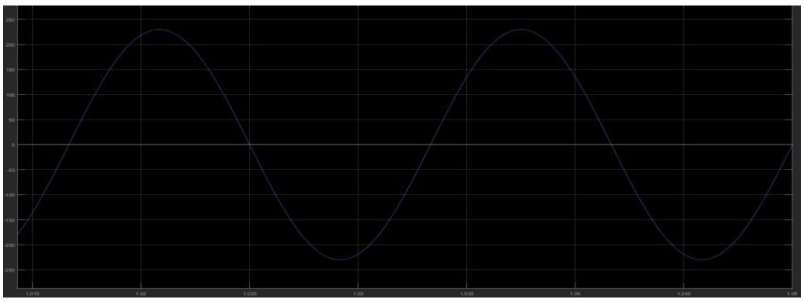

Fig.6. Grid -Tie Inverter simulation result

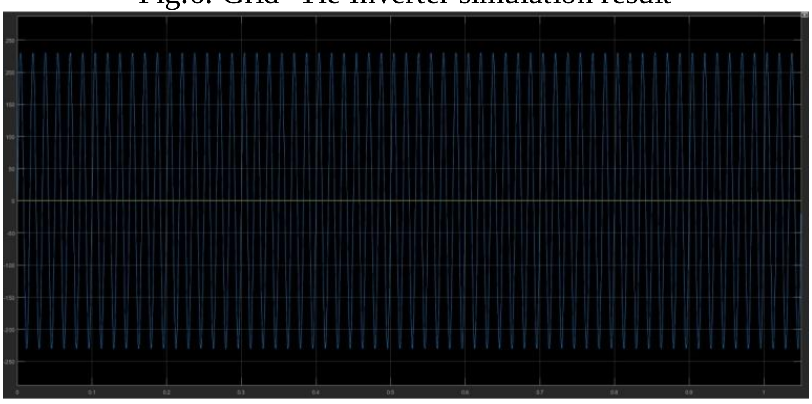

Fig.7. Electric vehicle charging station simulation result

CONCLUSION

An electric vehicle hybrid charging station is created and designed in this study. The suggested charging station model runs on a mix of grid and solar energy. The system functions as a whole to utilize electricity from the grid as effectively as feasible. The Simulink model is subjected to a thorough simulation analysis, and the findings are provided here. The outcomes demonstrate the system's efficacy in a range of operational scenarios. The created hybrid charging technique can be used to charge EVs more efficiently in the real world. The authors foresee hardware execution of the established hybrid charge mechanism as a future project.

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