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SOLAR AND GRID POWERED ELECTRIC VEHICLE CHARGING STATION CONTROL BY PROGRAMMABLE LOGIC CONTROLLER

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Abstract: This paper gives an overview of how PLC use to attain best power source among the different kinds of power sources like Grid supply and solar array system uses for electric vehicle charging stations. This technique works in both onshore and offshore settings. An electric grid supply with an AC/DC converter gives a constant and continues power supply to the EV charging stations this paper gives an overview of electric car charging stations that are powered by photovoltaic systems (PVS) And Grid Supply by utilizing a PLC, this system may change its energy source automatically in both shore and offshore settings. This concept also improves the automation of electric vehicle charging stations.

Keywords: Programmable Logic Controller, Photo Voltic System, Grid Power Supply, Vehicle-to-Grid Operation, Grid-to-Vehicle Operation, MPPT Technique

I. INTRODUCTION

Carbon emission from internal combustion engine cars is one of the most significant sources of pollution in the environment that's why our Indian government and citizens are promoting the use of electric vehicles, also our government has announced several schemes related to electric vehicles likes target of developing five to seven million electric vehicle and the ban of fossil fuel vehicle in upcoming years. It may result into increasing number of electric vehicles, as the number of electric vehicles increases it may also require increasing number of electric vehicles charging stations, and most of the present public charging stations uses electric grid power to charge electric vehicle but electric grid power is still. very dependent on fossil fuel thus charging of EV from electric grid power is indirect emission that's why this paper. introduce solar energy which is renewable energy with grid power to charge electric vehicle at charging station. They all are working as a different power source at charging station.

As I uses two power sources like PV array system, and grid supply to charge EV at charging station I use programmable logic controller to attain best power source among them to charge EV Also, with that introduce automation system at front end of charging station by using PLC. Main objective behind this paper is to attain best power source in between above power sources also with that it improves conventional system by designing the control panel that contains command to run the program that is design to control and monitor.

Figure1 shows the general architecture of the system deployed at an electric vehicle charging station It is a photovoltaic system with an energy storage system and with grid Supply to provide continuous supply at charging station. The chosen architecture has a central management system which allows for effective resource management and can apply a set of specified limits and priorities, such as prioritizing the utilization of solar energy or Battery Storage System for Electric Vehicle charging. A Programmable Logic Controller serves as the principal Control Unit for monitoring and operating the charging station (PLC).

II. BI-DIRECTIONAL BATTERY CHARGING OF EV FROM GRID SUPPLY

The general structure of EV bidirectional charging is shown in Figure 1. The charging structure considered in this paper for charging vehicle from grid supply is composed of a three-phase bidirectional AC/DC converter and an isolated bidirectional DC/DC converter which is shown in Fig. 4

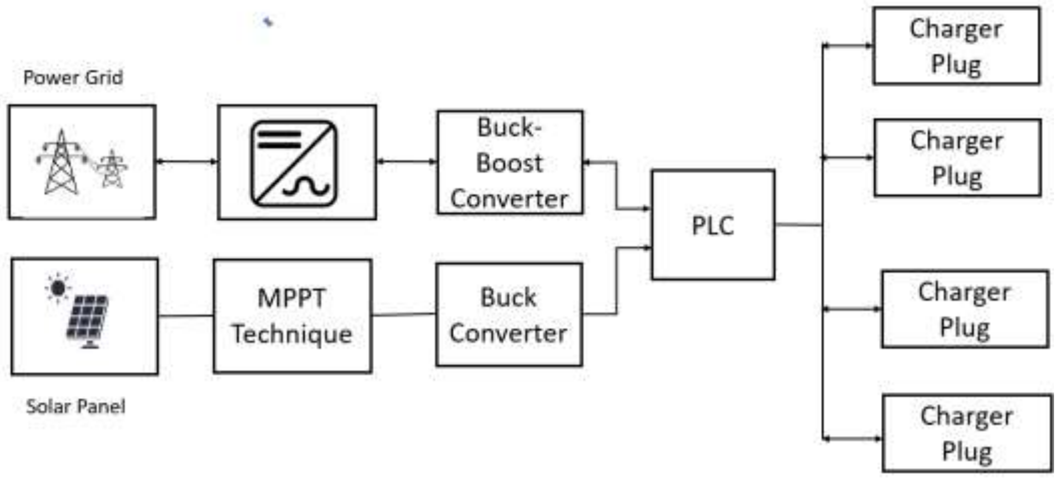


Fig. 1 The block Diagram of Charging System

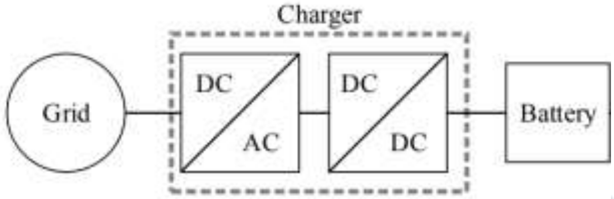


Figure 2 – Structure of Charging System of Electric Vehicle by Using Grid Supply

A) Active Front end converter

The LCL filter shown in fig.4 and fig.3 is a front-end converter which is also known as active rectifier which reduces the grid current ripple to ensure low harmonic distortion (THD)
The LCL filter's transfer function is established as:

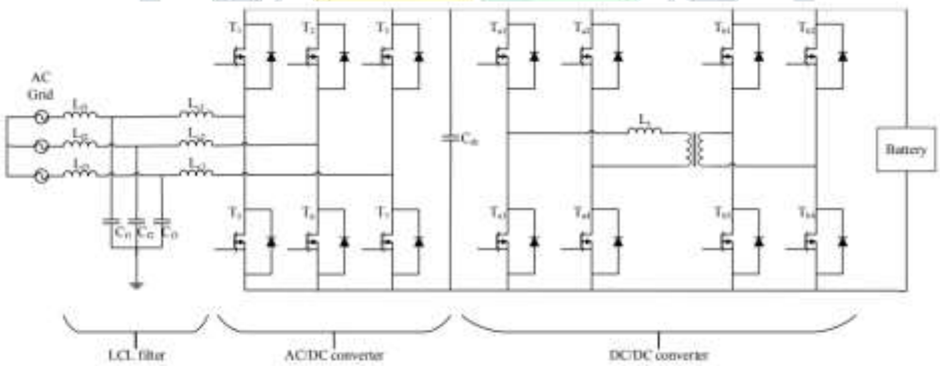
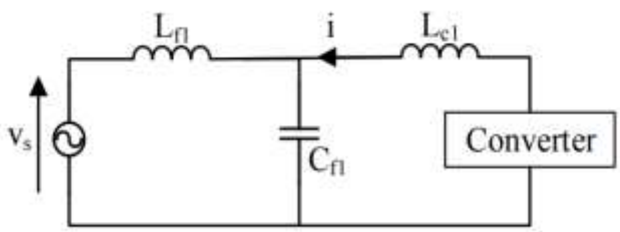


Figure 3– Circuit Diagram for V2G And G2V Charging from Three Phase Grid Supply



$$\frac{i(s)}{v_s(s)} = \frac{1}{L_c s}\left(\frac{L_f L_c C_f s^2 + L_c}{L_f L_c C_f s^2 + (L_f + L_c)}\right)$$

Figure 4– Single phase circuit of a LCL Filter

The single-phase circuit of the grid – side filter is shown in Fig-3. Where the values of L_f, L_c and C_f have to choose while maintaining the systems overall stability.

B) AC/DC Converter

AC-DC converters are electrical circuits that convert alternating current (AC) input into direct current (DC) output. AC-DC converters are electrical circuits that convert alternating current (AC) input into direct current (DC) output. Rectification is the process of converting alternating current to direct current. At the load end connection, the rectifier transforms the AC supply to DC. The three phase VSI AC/DC converter is used in this application (Voltage Source Inverter). This is a bidirectional converter that allows power to flow from and to the car battery. The nature of the switches used can be changed to accommodate a wide range of charging power levels. The DC link at the output of the AC/DC converter is regulated at for an EV.

C) DC/DC Converter

DC-to-DC converters change the level of DC voltage from one level to another. A Dual Active Bridge (DAB) with DC/DC converter is connected to the battery. The key characteristics of this arrangement are the isolation provided by the transformer between the battery and the grid, which is significant for a variety of reasons, including safety. The DAB is a bidirectional converter that may assure the vehicle's proper V2G and G2V operation.

III. Simulation of V2G and G2V Operation of a Bidirectional Battery Charging of EV

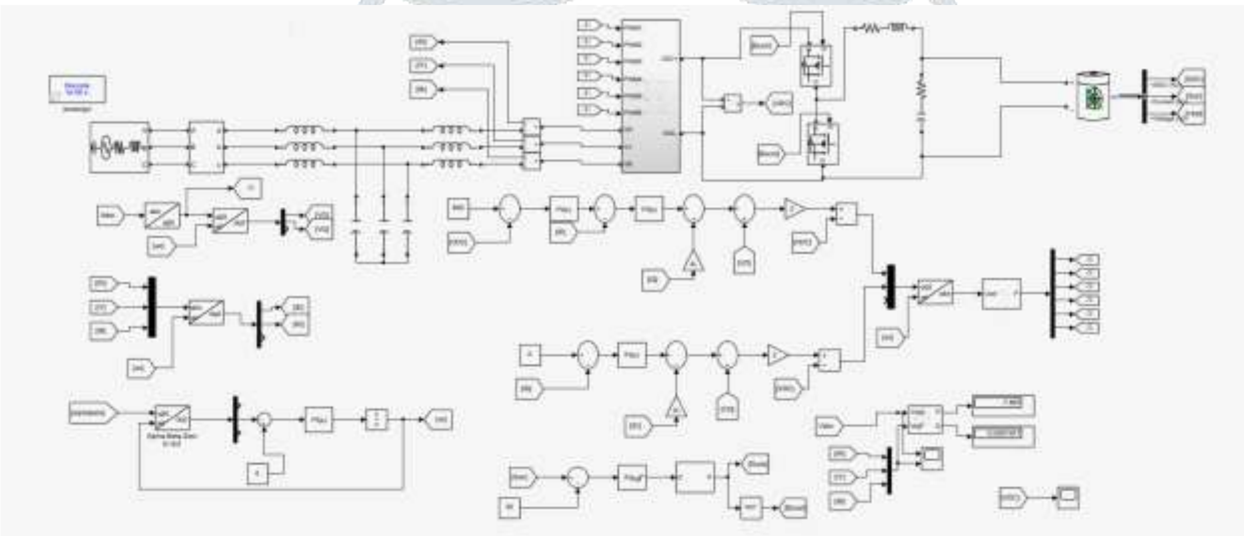
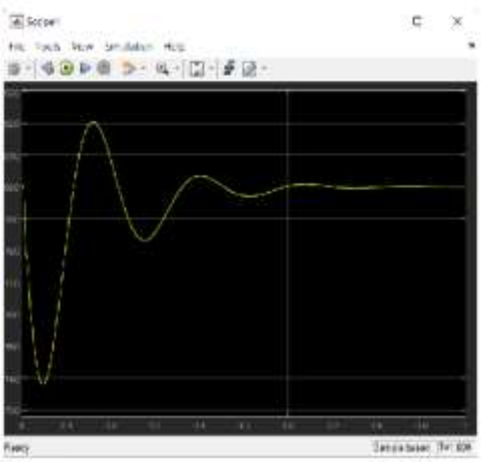
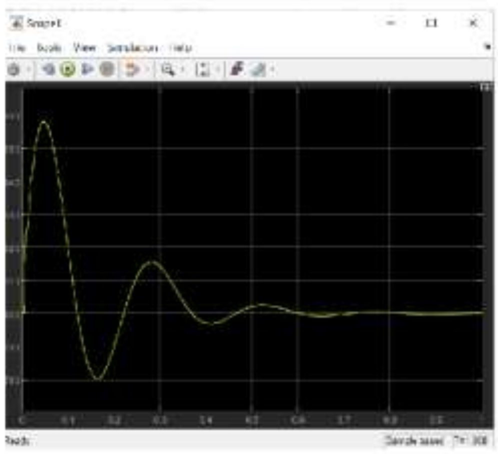


Figure 5– Simulation of V2G and G2V operation of a bidirectional battery charging of EV





Because the charger is totally bidirectional, the battery may pump electricity into the grid when needed and with proper management. The AC/DC control remains the same since its primary job is to manage the DC link voltage, which must remain constant whether the charger is in G2V or V2G mode. However, the DC/DC control changes the battery power was chosen as the reference for this mode of operation since the battery, which is regarded the source in the V2G mode, can only inject a certain amount of power. This control will allow for a power factor of one at the AC mains. As per the results Here it shows that when the active power is positive it means that the power is flow from battery to the grid and the system is working in vehicle to grid mode and vehicle get discharge to the grid as per the result1 and result 2 shows that battery is getting charge from grid that means circuit is operated in G2V mode.

IV. CHARGING OF EV BATTERY BY USING PHOTOVOLTAIC SYSTEM

The solar array is the fundamental power conversion unit of a photovoltaic system, and the modules have a long lifetime. Solar energy may be used in two ways: to generate power and solar heating or cooling. Because the energy produced by solar PV arrays is dependent on insolation, array voltage, and temperature, it is important to extract the maximum power from the solar panels/arrays in order for the solar panels to perform efficiently. The simulation in this study is based on a lead acid battery. Although lead acid batteries have been used for many hundred years, they are now more widely used

in solar systems due to their ease of availability, low cost, efficiency, dependability, longevity, and maintenance-free operation. The charge controller is regarded as one of the most important technologies in solar systems for securely charging lead acid batteries and improving charge efficiency. A charge controller's principal duty is to keep a lead-acid battery from overcharging. Aside from that, the PV system's unpredictable voltage may cause harm to the load. According to research, if a charge controller is not used, the battery's life would be reduced. As a result, a charge controller that will extend the battery's life is required.

When the battery voltage is detected, the charge controller will reduce or stop charging current. The battery voltage reaches a predetermined level known as the overcharging level.in which the battery's electrolyte solution begins the chemical degradation and gas generation This is necessary. where electrolyte is lost in sealed lead-acid battery During overcharging, it cannot be replaced. The charger additionally investigates and regulates the charging current to the battery the ON/OFF switch of the converter. A MPPT charge controller or control system is to keep the converter input voltage constant despite changes in other

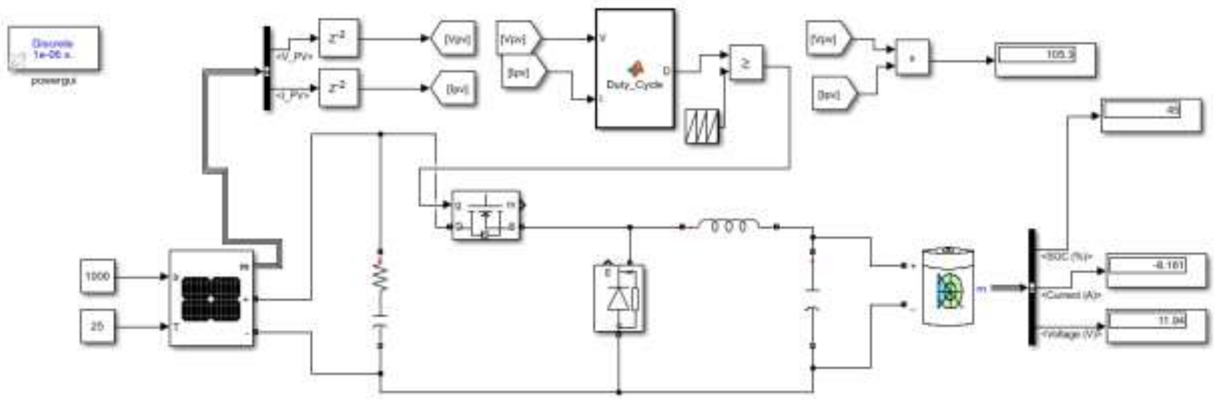


Figure 6– Simulation Diagram of Charging EV from PV array (Solar System) by using MPPT

parameters like output voltage, load current, and so on. An MPPT charge controller is required to achieve the highest power output from the PV panels. Fig. 8. shows the control part designed for the buck converter to get the maximum output from solar PV Panels. Fig 6 shows the simulation of charging of EV battery by using photovoltaic system.

V. PROGRAMMABLE LOGIC CONTROLLER

The fundamental problem with maintaining supply continuity is that it is inefficient for manufacturers and industries to experience frequent power outages. The issue associated with manual switching is primarily alleviated by the changeover mechanism. The development and design of an auto-changeover system based on a PLC can be used to describe this paper. The main thought that comes to mind when we think of the world is the increase in PLC automation. PLC is a very effective instrument for automating the controlling, monitoring, and integrating system. PLC can withstand in any condition, including changes in temperature, humidity, noise, and wetness. There is no need for expertise for the controlling and handling; it can be used with ease.

In this project, the PLC system is used to Programmable Logic Controller of MicroLogix Company. PLC is also referred to as programmable controllers that are used in commercial andindustrial applications. which has a 10 digital output and 2 analog inputs and 6 outputs. TON - Timer ON Delay is used to the Generator ON. TOFF - Timer OFF Delay is used to the Generator OFF. Input1 is connected to the output1 and the output1 glows that means charging station is connected to the PV system, then the solar system is unable to give sufficient charging at charging station PLC will give command to the contactor and Relays to change the power source from solar to grid supply and the whole load at charging station connects to the grid supply without failure of power supply and when solar is able to gives us energy at that time PLC will give command to the grid contactor to deenergize and PV system contactors will get energize and charging station will automatically get connected to solar(PV) system also with that two electromagnetic sensors are connected at entry and exit get which measures number of vehicles enters and exit from charging station and it displays on display outside the charging station when the charging station is full of vehicles than it will turn on the red light on display that means there is no space at charging station to charge your vehicle so wait for some time otherwise it turns on green light.

Table 1. List of Programming Symbols

Symbol	Type	Comment
I:1/0	Input	Supply
I:1/3	Input	Electromagnetic Sensor
I:1/4	Input	Electromagnetic Sensor
O:2/0	Output	PV System Contactor
O:2/1	Output	Grid System Contactor
O:2/2	Output	Red Light
O:2/3	Output	Green Light
T4:0	Timer ON Delay	To Start the Grid Supply
T4:1	Timer OFF Delay	To Stop the Grid Supply
C5:0	Counter Up	To Count the no. of Changeover
C5:1	Counter Up	To count number of vehicles, present inside charging station
C5:1	Counter Down	To count number of vehicles, Exit from charging station

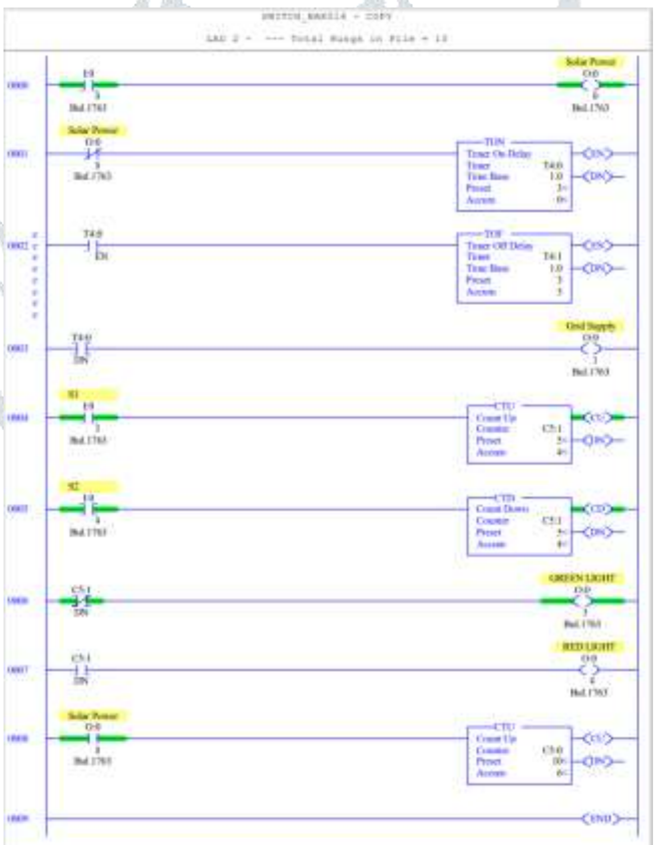


Fig7. Ladder Diagram for Automatic Change Over

CONCLUSION

This paper includes a model of a PV-based with grid supplied rapid charging station with a power flow interaction. Each component's model and associated control approach, including the grid-supply bidirectional AC/DC converter, the EV interfaced DC/DC buck-boost converter, and the PV interfaced DC/DC converter, are described along with how they were implemented in Simulink. In this paper, design and implementation procedures for a PLC-based automatic changeover switch are being established. The total system is designed to be easy and quick to operate, which can increase system stability and speed and increase reliability.

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