Design and Simulation of Advanced Solar power Electric Vehicle Charging Station

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Abstract
The main aim of this thesis is to design such a charging station coupled with solar energy for urban cities. Simplified EV load models are developed by considering most popular commercial EV in the market. The designed solar powered charging station is tested with the developed EV load models and, would be located in selected urban cities. In this paper, battery of electric vehicle is charge through two source, solar and electricity board. Solar is primary source, if any case solar isn't working (in winter season or rainy season), EV draws power from electricity board.

Keywords: Solar Power, Electric Vehicle

I. Introduction

From portable electronics to electric vehicles (EVs), batteries are widely used as a main energy source in many applications. Interest in batteries for EVs can be traced back to the mid-19th century when the first EV came into existence. Today, since EVs can reduce gasoline consumption up to 75The U.S. Council for Automotive Research (USCAR) and the U.S. Advanced Bat- tery Consortium (USABC) have set minimum goals for battery characteristics for the long-term commercialization of advanced batteries in EVs and hybrid electric vehicles (HEVs). To enlarge the market share of EVs and HEVs, safety and reliabil- ity are the top concerns of users. However, both of them are subject to not only the battery technology but also the management system for the battery. Therefore, a battery management system (BMS), as the connector between the battery and the vehicle, plays a vital role in improving battery performance and optimizing vehicle operation in a safe and reliable manner. Pure-electric and plug-in hybrid electric vehicles, hereafter denoted as Plug-in Electric Vehicles (PEVs), are more and more running on the roads. They represent an effective solution to the increasing worry about environmental pollution and energy consumption of the thermal vehicles. PEV batteries are recharged from the utility by help of either a house connection or a recharging bollard. In Europe, the house connection provides electric energy from a single phase 230V outlet whilst the recharging bollard does it from a three-phase 400V outlet. Almost all the PEVs are fitted with battery chargers that comply with both the outlets. Different types of Electric Vehicles (EVs) are being developed nowadays as alternative to the Internal Combustion Engines (ICE) vehicles, namely, Battery.Electric Vehicles (BEV), Plug-in Hybrid Electric Vehicles (PHEV), in its differ ent configurations, and Fuel-Cell Electric Vehicles (FCEV). Nevertheless, they are usually used in conjunction with ultra capacitors to store energy during transient moments, as during the vehicle regenerative braking. Actually, the ultra-capacitors are used in this way to receive a significant amount of energy in a short time, and to provide this energy to the next acceleration, or to help charging the batteries. The electrical power grids were not designed for this new type of load, which corresponds to the batteries charging systems of EVs, therefore the impact caused by the proliferation of EVs cannot be neglected. The challenge is to rebuild the electrical power grids, as early as possible, as "smarter" as possible, and the most environmentally friendly as possible.

II. PROBLEM STATEMENT

The hybrid power generation systems are installed through parallel connection of two or more conventional and renewable energy generation systems to each other. The hybrid power generation systems are one of the best solution methods to meet the electric energy need of mini or micro networks far distance from energy generation and distribution centers and of small settlement units. Most commonly, the wind-solar hybrid power generation system is used. For electric generation systems in various structures, recently, hybrid energy generation systems are realized by combining mainly the wind and the solar energy and fuel cell and soon. However, as more staff will be used for hybrid energy generation systems installed with more than one renewable energy source, the cost and installation area need will increase and structure and inspection of the system will become complicated. In this paper, a battery-supported hybrid wind-solar energy generation system with switching power flow control is presented to supply stable electrical power.

III. BASIC CONCEPTS OF SOLAR ELECTRIC VEHICLE

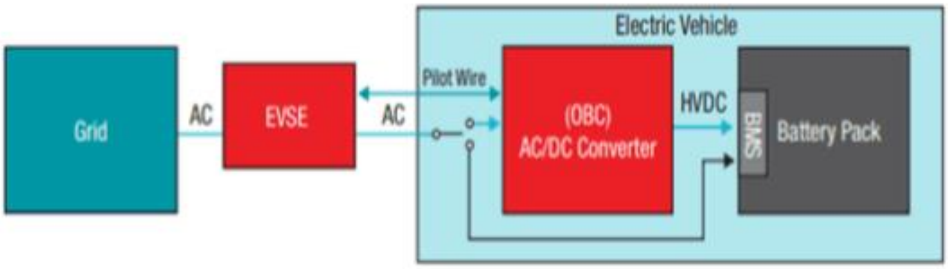
As the world is gearing up to unleash an EV revolution, it is still true that the rate of adaption is slow. Electric Vehicles (EVs) despite being a greener, smoother and cheaper mode of transport does not seem to be practical yet. The reason is two words, Cost and Ecosystem. Currently EV's are priced substantially at par with Gasoline cars making it a less significant choice for buyers, the advancement in battery technology and government schemes are expected to bring down the cost of EV in Future.

Electric Vehicle Supply (EVS)

The equipment's that constitute an Electric Vehicle Charging Station are collectively called as Electric Vehicle Supply Equipment (EVSE). The term is more popular, and it refers nothing but to the charging stations. Some people also refer it as ECS which stands for Electric charging station. An EVSE is designed and engineered to charge a battery pack by using the grid for Power Delivery; these battery packs might be present in an Electric Vehicle (EV) or in a Plug-in Electric Vehicle (PEV). The power, connector and protocol for these EVSE will vary based on it design which we will discuss in this article.

Types of EV Charging Stations (EVSE)

Charging Stations can be broadly classified into two types, AC charging Station and DC charging Station. An AC charging Station as the name implies provides AC power form the grid to the EV which is then converted to DC using the On board charger to charge the vehicle. These chargers are also called the Level 1 and Level 2 Chargers which is used in residential and commercial places. The advantage of an AC charging station is that the on-board charger will regulate the voltage and current as required for the EV hence it is not mandatory for the charging station to communicate to the EV. The disadvantage is its low output power which increase the charging time. A typical AC charging system is show in the below picture. As we can see the AC from grid is supplied directly to OBC through EVSE, the OBC then converts it to DC and chargers the battery through the BMS. The Pilot wire is used to sense the type of charger connected to the EV and set the required input current for the OBC.



A DC charging Station gets AC power form the grid and converts it to DC voltage and uses it charge the Battery pack directly by by-passing the On-board Charger (OBS). These chargers normally output high voltage of upto 600V and current upto 400A which enables the EV to be charged in less than 30 minutes as compared with 8-16 hours on AC charger. These are also called Level 3 chargers and commonly known as DC Fast Chargers (DCFC) or Super chargers. The advantage of this type of charger is its fast charging time while the disadvantage is its complex engineering where it needs to communicate with EV to charge it efficiently and safely. A typical DC charging system is shown below, as you can see the EVSE provides DC directly to Battery pack bypassing the OBS. The EVSE is arranged in stacks to provide high current.gh c current due to power switch limitations.

Charging Station Type	**Charger Level**	**AC Supply Voltage and Current**	**Charger Power**	**Time to charge a 24kWH battery Pack**
AC charging Station	Level 1 - Residential	Single Phase – 120/230V and ~12 to 16A	~1.44 kW to ~1.92kW	~ 17 Hours
AC charging Station	Level 2 - Commercial	Split Phase – 208/240V and ~15 to 80A	~3.1 kW to ~19.2 kW	~ 8 Hours
DC charging Station	Level 3 – Supercharger	Single Phase – 300/600V and ~400A	~120 kW to ~240 kW	~ 30 minutes

Plug-in Electric Vehicles (PEVs)

Plug-in electric vehicles (PEVs) use electricity from the energy grid to charge large battery packs, then use the batteries to power an electric motor. They are primarily powered by electricity instead of liquid fuels and produce no tailpipe emissions. Plug-in vehicles can also generate power from regenerative braking systems, which convert kinetic energy from the vehicle's brakes into electricity that is stored in the battery pack. Since plug-in vehicles rely on rechargeable batteries for power, each vehicle has an electric range—the maximum number of miles it can travel on battery power before it needs to recharge. Applications for these vehicles go be yond just passenger cars (though U.S. consumer passenger PEVs are largely the focus of this fact sheet), as there are currently plug-in electric buses, utility trucks, high-performance vehicles, and motorcycles. There are two main types of plug-in electric vehicles: • All-electric (or battery electric) vehicles (BEVs) only use electric power from the grid; they do not have an internal combustion engine and do not use any type of liquid fuel. BEVs use large battery packs to give the vehicle a long electric range, with some traveling up to 335 miles on a single charge.

IV. PROPOSED SYSTEM

The main aim of this paper is to analyses the potential for zero carbon car travel by exploring whether: Zero carbon personal car travel is technically possible and affordable, and can be achieved in the next five years ; and Zero carbon personal car travel compares to present transport systems, when considered their cost, co-benefits, attractiveness and convenience,.

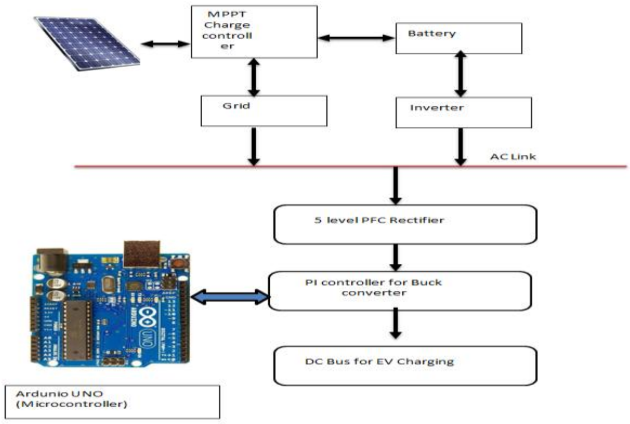


Fig.5.1 Architecture of proposed system

V. DESIGN OF ELECTRIC VEHICLES CHARGING STATION

Electric Vehicle Charging Station

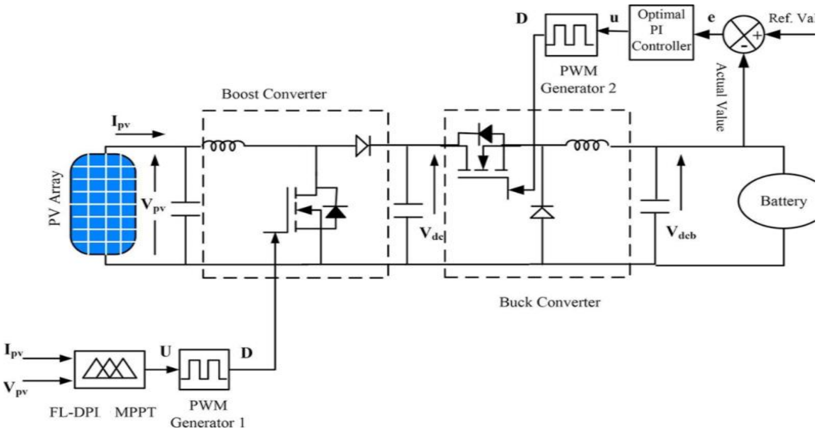


Fig circuit diagram of proposed system

Above circuit diagram to the connection of circuit which is consist of what parameters used and proposed circuit we have used there is detailed explanation step by step in below chapters.

Vehicle charging system:

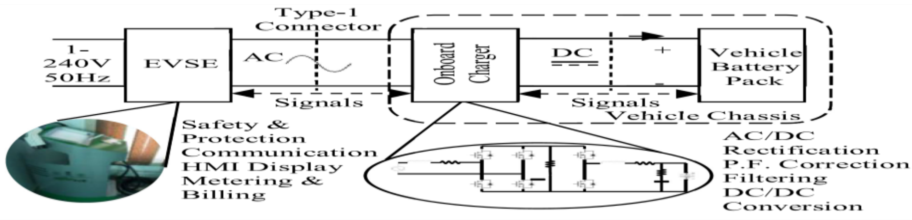


Fig. 3. Vehicle charging system.

Fig Vehicle charging station

Controller circuit:

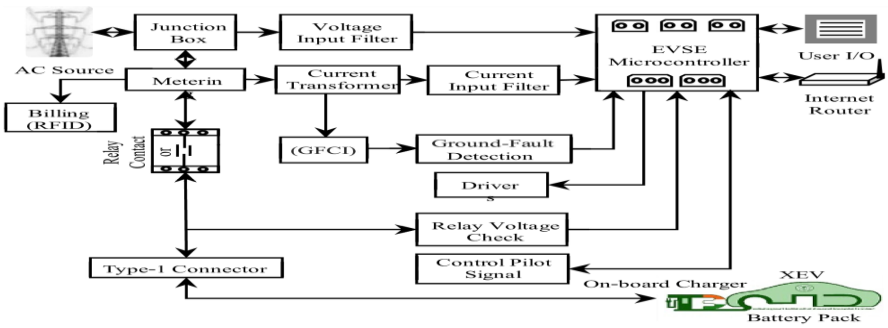


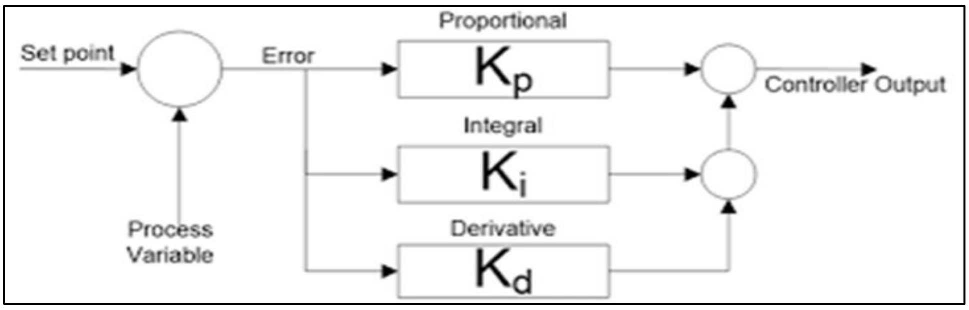
Fig - Charging controller circuit

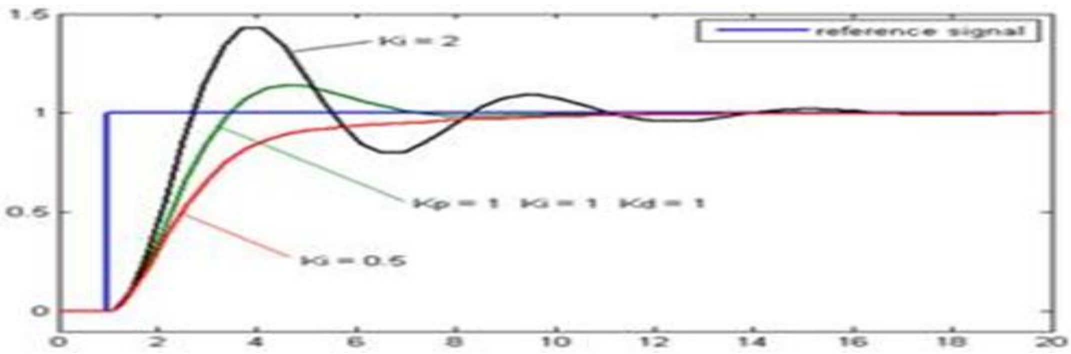
Figure shows the charging controller circuit schematics. Various functions are performed through the EVSE by using the relays of high power rating in the circuit. For safely operating the relay, a driver with a suitable protection circuit should be applied as the following.

- An overcurrent relay (solid state type) for short circuit and overload protection.
- An electronic contactors witch for latching-up the connector with the supply.
- A controller circuitry which interfaces the on board charger and provides line-to-ground fault protection.

VI. IMPLEMENTATION OF PROPOSED METHODOLOGY

With the use of a low cost simple ON-OFF controller, only two control states are possible, like fully ON or fully OFF. It is used for a limited control application where these two control states are enough for the control objective. However oscillating nature of this control limits its usage and hence it is being replaced by PID controllers. PID controller maintains the output such that there is zero error between the process variable and set point/ desired output by closed-loop operations. PID uses three basic control behaviors that are explained below Proportional or P- controller gives an output that is proportional to current error e (t). It compares the desired or set point with the actual value or feedback process value. The resulting error is multiplied with a proportional constant to get the output. If the error value is zero, then this controller output is zero.

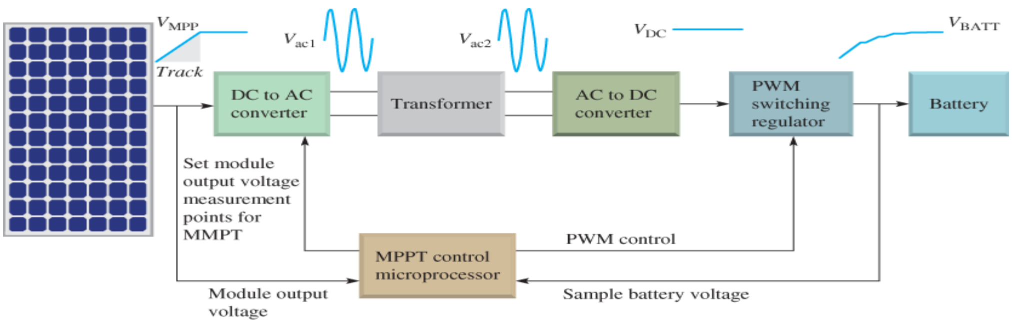




So finally we observed that by combining these three controllers, we can get the desired response for the system. Different manufacturers design different PID algorithms.

Maximum power point tracking:

It isolates the dc input from the dc output, so the output can be adjusted for maximum power. Figure 6.10 Operation of an MPPT Charge Controller Perturb and observe; an algorithm that changes a parameter and observes the results The load is varied and the power is monitored to find the highest power. This is the same as the perturb and observe algorithm.



VII. EXPERIMENTAL SETUP

Hardware Requirement

1. Solar panel: solar energy begins with the sun. Solar panels (also known as "PV panels") are used to convert light from the sun, which is composed of particles of energy called "photons", into electricity that can be used to power electrical loads. Solar panels can be used for a wide variety of applications including remote power systems for cabins, telecommunications equipment, remote sensing, and of course for the production of electricity by residential and commercial solar electric systems.

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We have used solar panel of 4 series modules with 2 parallel strings for simulation. It is used to charge battery of electric vehicle.

Type of Product : Polycrystalline Solar Panel
Rated Power Range : 1-30 W
Watt : 5 W
Voltage at Pmax (V) : 8.3 V
Module Voltage : 6 V

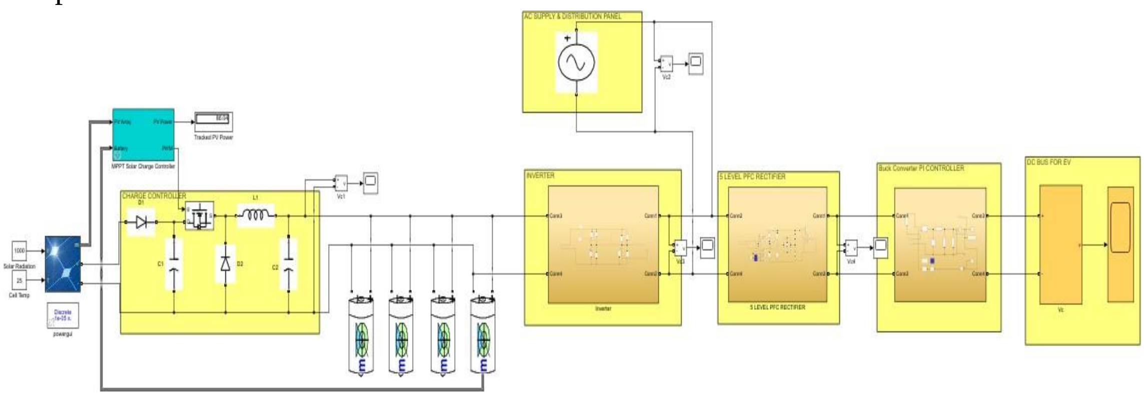
2. Battery: battery is charged from solar panel. Electric vehicles use lithium-ion batteries of various designs, similar to those used in cell phones and laptop computers, only on a much larger scale. Lithium-ion batteries have a high energy density and are less likely than other types of batteries to lose their charge when not being used. An EV's battery capacity is expressed in terms of kilowatt-hours, which is abbreviated as kWh. More is better here.

Voltage- 12V
Battery Capacity- 1.3Ah
Terminal Standard F3-TAB 187E

Operation Temperature :
Charge 0°C (32°F) - 40°C (104°F)
Discharge -20°C (-4°F) - 50°C (122°F)
Storage -20°C (-4°F) - 40°C (104°F)
Capacity 25° (77°F)
20 hour rate (0.165A) 1.3AH
10 hour rate 1.17AH
5 hour rate 1.04AH
1 hour rate (1.98A) 0.78AH

VIII. RESULTS AND DISCUSSIONS

MATLAB Simulation of "Design and Simulation Of Advanced Solar-Powered Electric Vehicl Charging Station" is shown in fig 9.1. It consists of charge controller, invert Station" is show in fig 9.1. It consists of charge controller, inverter, rectifier, PI controller and distribution panel. rectifier, PI controller and distribution panel.



IX. CONCLUSIONS

Electric vehicles are a zero emissions transport technology. Charged from renewable electricity, and with no tailpipe emissions, EVs are a personal transport solution that can help address climate change while also delivering a range of benefits. EV technology, especially batteries, is advancing rapidly and prices continue to fall. We are rapidly approaching a cross-over point where the lifetime costs of ICEs are greater than that of electric cars. Moreover, there has been an explosion in the development of a diverse range of electric personal mobility devices, such as electric bicycles and scooters. The transport sector is electrifying and diversifying, all at the same time. Most importantly, a shift to 100 per cent EVs for urban travel alone would eliminate six per cent of greenhouse gas emissions. This would increase to 8 per cent of emissions if regional car travel is also included. This would make a major dent in India's emissions and bring India closer to a zero emissions economy. EV charging promotes the self-consumption of PV and these results in increased PV revenues when feed-in tariffs are lower than retail electricity price. Thus the dual benefit of lower fuel cost and emission make EV charging from PV to be both economical and environmentally beneficial. If in case, sunlight is not available then one can use power from electricity board, making it uninterrupted power supply.

X. REFERENCES

1. Samir M. Shariff, Mohammad Saad Alam, Furkan Ahmad , Yasser Rafat, M. Syed JamilAsghar and Saadullah Khan, "System Design and Realization of a Solar-Powered Electric Vehicle Charging Station", IEEE SYSTEMS JOURNAL, 1937-9234 © 2019 IEEE
2. Energies 2011, 4, 1840-1857; doi:10.3390/en4111840 energies ISSN 1996- 107 www.mdpi.com/journal/energies Review Battery Management Systems in Electric and Hybrid Vehicles Yinjiao Xing 1 , Eden W. M. Ma 1, Kwok L.Tsui 1,2and Michael Pecht
3. Hu, X., Zou, C., Zhang, C., Li, Y. (2017). Technological Developments in Batteries: A Survey of Principal Roles, Types, and Management Needs. IEEE Power and Energy Magazine, 15(5), 20–31. doi:10.1109/mpe.2017.2708812
4. Caspar, M., Eiler, T., Hohmann, S. (2014). Comparison of Active Bat- tery Balancing Systems. 2014 IEEE Vehicle Power and Propulsion Conference (VPPC). doi:10.1109/vppc.2014.7007027
5. Cao, J., Schofield, N., Emadi, A. (2008). Battery balancing methods: A comprehensive review. 2008 IEEE Vehicle Power and Propulsion Confer- ence. doi:10.1109/vppc.2008.467766