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Design of Optimised Energy Trading Sysyem for V2G & G2V Configuration Based on State of Charge Approach

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ABSTRACT

This paper presents the design of optimized energy trading system for V2G & G2V configuration based on state of charge approach. The current circumstances in the transport sector portray the acute rise in fuel demands and need of substitute fuel resources. All forms of electric vehicles that are driven by the energy stored in the battery will be a better solution to meet the transport sector needs. This system needs stabilization of storage units and optimization. Currently batteries are filled in with charge through conductive AC charging methods, Electric vehicle supply equipment (EVSE) is connected to Electric vehicle (EV) for charging the battery. Nowadays the penetration of motor operated transportation is around 25 % approximately and the same will be at exponential growth in the future and that would be a burden to the electric infrastructure. In such scenario if the EVs are modified as storage unit and recover the same and feed back to the grid when vehicle is not in use would be a viable solution and the objective of this system is to demonstrate Smart Building (SB) with charging system that creates interaction with energy storage devices, also power EVs for grid load shifting, peak trimming, and reduction of annual energy usage. This V2G and G2V system uses a split pi optimization algorithm that provides an optimized interfacing, quick charging and discharging, battery backup, and reliability. The SOC of the vehicles are collected and which vehicle needs to be charged is charged by the charging infrastructure and from other vehicles the energy is recovered and pumped back to the grid by the infrastructure and the process continues vice-versa. The main challenges that are discussed and analyzed. Using a V2G and G2V simulation model that is presented to describe various parameters affecting the grid-interface network.

KEYWORDS: Vehicle-to-Grid (V2G),Grid- to- Vehicle (G2V),charging and Discharging, State of Charge (SOC)

1. INTRODUCTION

Motor operated transport systems are going to be the substitute for the internal combustion operated system. In the current situation, the manufacturing and utilization are exponentially rising day by day. Considering now, we may have a lesser number of vehicles that draw power from the existing electrical infrastructure but, in future the number of vehicles will be on a higher side, so the energy demand will be increasing. In the order of reducing this power consumption the generation of electricity can be more economized by saving the non-renewable sources like coal, petrol, diesel etc.,. The Solar, AC Supply and combined Battery Storage working will give the alternate solution for charging the battery without the main supply. By the principle of charging effect, it gets converted into electrical energy.

The AC Supply energy can be solar energy or exhaust heat energy. This process uses renewable energy resources which are profitable, eco-friendly and a compact module of the solar panel. The charging of the inverter battery is mostly done by taking power from the mains. Where the alternating current from the supply is rectified and given to the battery for charging. By this process, there is a profusion of power in the system. Also solar panels are used for charging the same inverter battery, in this the light energy is converted to electrical energy and stored in the battery. This process needs a large investment, the radiation emitted by this is hazardous to living organisms presented there.

Nowadays, there is a demand to increase the power generation capacity because of steadily rising electrical energy consumption. In order to achieve this, renewable energy sources are the best option. However, the reserves of fossil fuels will soon be depleted, since oil is a limited resource. So to overcome this we can use renewable energy sources as it will also provide a cleaner environment for future generations.

Renewable energy can be created by many methods; for example, solar energy, AC Supply energy, hydro energy, nuclear energy, and many more. For each of these different forms of creating electricity, there are certain limitations. Among all the renewable energy sources, solar power generation tops the list. But solar energy can only be created when there is sunlight, so to overcome this we can hybridize with other technologies, here using hybrid generation of the solar and AC Supply Energy plate. So when there is no sun then we can generate energy using the AC Supply Energy plate. The solar and AC Supply Energy energy obtained is stored in a battery. By hybrid which increases cell life, improves performance, and provides operational benefits under different environmental conditions.The battery which is used can be recharged with the two generation inputs like solar and AC Supply Energy. The battery is connected to the inverter. The cost minimization of grid systems for isolated communities considering hydro power also as a source, there is a lack of storage units. Penetration of renewable energy sources (RES) into conventional based generation systems for isolated regions can be beneficial in both economic and environmental credits which includes fuel and co2 emissions are considered.

To overcome the lack of storage of energy units we prefer the electric vehicles as transport systems as well as a storage unit. The annual cost of the grid will be reduced by optimal configuration considering the load demand by preferring electrical vehicles as storage units of energy for a certain period. Optimalsizing of distributed generators by using genetic algorithms can be used for loss minimization which does not consider cost reduction. Power dispatch operations of generators create new problems with cost estimation and economic dispatch. Economic operation of a grid with time of use price is proposed on considering the energy storage with optimal scheduling of generation.

2.OPPORTUNITIES AND OBSTACLES OF ALREADY AVAILABLE SYSTEM

In DC network frame works matrix battery stockpiling units are utilized to help the fundamental wellspring of environmentally friendly power (PV exhibit) in giving stable voltage on the DC transport, The micro grid configuration utilizes three units of PV clusters and every unit comprises of two PV exhibits and two batteries. The PID regulator is viably utilized as a lift converter in raising or bringing down the voltage. The advantage of using two battery amassing systems is that accepting one unit isn't satisfactory to give a voltage to the DC transport, then, the battery unit on the AC grid side will similarly rapidly give a voltage to the DC transport. Generally there are three kinds of little system structures, specifically smaller than usual DC grid, scaled down cross section AC, and smaller than expected organization with DC and AC transport. There are various energy amassing systems that can be used in smaller than normal cross section structures. The most frequently used limit structures are battery, ultra-capacitor, flywheel. The put away energy can be utilized to invigorate the heap. To handle the issue of power age, the PV energy source can be facilitated with various sources to meet the openness of long stretch energy sources. This is for capacity frame works two units of batteries were utilized. The primary battery unit is associated with the sun based cell, while different batteries are associated through a low voltage power lattice. The main battery unit utilizes a bidirectional

DC-DC converter, while different batteries utilize a DC-DC converter not bidirectional.

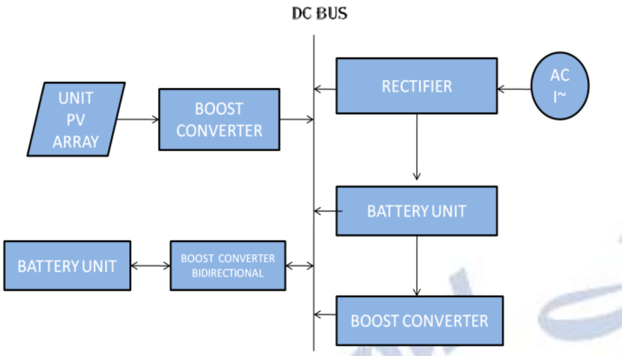

FIG 1.BLOCK DIAGRAM OF AVAILABLE SYSTEM

3. OPTIMIZED ENERGY TRADING SYSTEM FOR V2G AND G2V CONFIGURATIONBASED ON SOC APPROACH

a). V2G AND G2V SYSTEM

As of late, there has been a worldwide clamor for the de carbonization of energy frameworks to give a safe and practical energy supply while eliminating ozone harming substance emanations with an end goal to keep away from an unnatural weather change. With the blast being used for battery energy stockpiling, electric vehicles are considered an efficient eco-accommodating method for transportation. They likewise assume apart through their association with power matrices, conveying power just as controlling the charging rate for a quicker charging time. EVs can meet this job because of Grid-to-vehicle (G2V) and vehicle-to-grid (V2G) activity, giving bidirectional power flow to handle the twin difficulties of quicker charging and offering subordinate types of assistance to the network. "Grid- to-Vehicle(G2V) and Vehicle-to-Grid(V2G) Technologies "such as arrangements in G2V and V2G, including however not restricted to the activity and control of grid able vehicles, energy stock piling and the executives frameworks, charging foundation and chargers, load determining for conveyed systems,V2G interfaces, correspondence norms, and charging geographies just as on mental effects and financial benefits.

A micro grid ought to be noticeable as a little energy network made from loads, Distributed Generators ,and every so often, Energy Storage Systems to assist with providing demands . In addition, the utilization of ESS is extending and ending up being incredibly ordinary. These advancements are significantly changing the energy scene, spreading the possibility of micro grids.

b). Bi-Directional Half-Bridge and Full-Bridge Controlled Converter

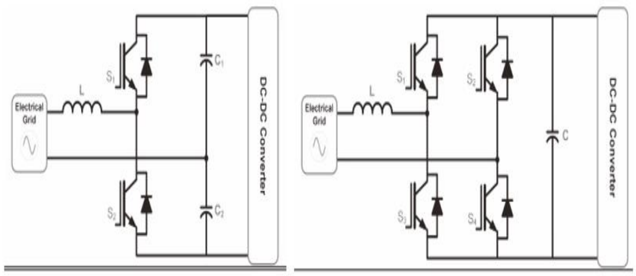

FIG 2. BI DIRECTIONAL HALF BRIDGE AND FULL BRIDGE CONVETER

The circuit diagram of a bi-directional half-bridge and full-bridge controlled converter is given. In the bidirectional half-bridge-controlled converter, the AC energy from the grid is changed over into DC energy in half-bridge with the exchanging components and is diminished to the voltage level of the battery by utilizing the converter (buck converter). Simultaneously, the DC received from the battery is amplified by the boost converter circuit, which builds the voltage and afterward gives it to the grid by changing over it from DC to AC through diode.

The AC energy got from the power lattice is changed over into DC energy in half-span with the exchanging components and is diminished to the voltage level of the battery by utilizing the converter (buck converter). Simultaneously, the DC got from the battery is amplified by the lift converter circuit, which expands the voltage and afterward gives it to the framework by switching it from DC over completely to AC through diode. In the bidirectional full-span controlled converter, the transformation cycle from AC to DC is finished through a full-span converter circuit.The other parts are the same as the bidirectional half-bridge-controlled converter from the primary side to the low voltage (LV) and high current on the secondary side and vice-versa

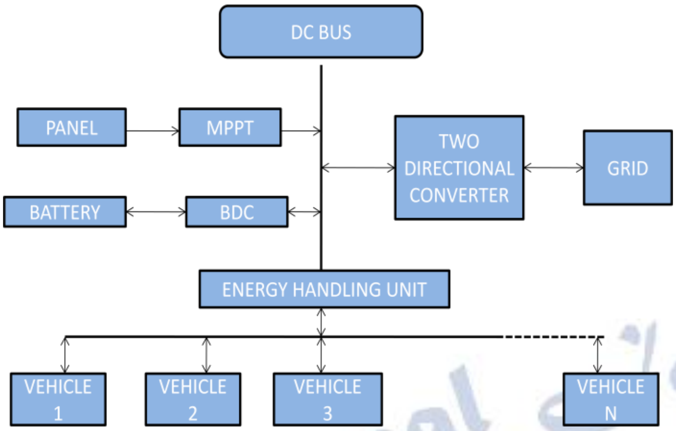

FIG 3 BLOCK DIAGRAM OF POWER GENERATION SYSTEM USING AC SUPPLY ENERGY MODULE.

d). PI Controller

A P.I Controller is a feedback control loop that calculates an error signal by taking the difference between the output of a system, which in this case is the power being drawn from the battery, and the set point. PI control stops the system from fluctuating, and it is also able to return the system to its set point.

4.SIMULATION

I. Charging simulation of various vehicle

The Figure. 4 Shows V2G and G2V Mat lab Simulation for Various Battery Charging Circuit.

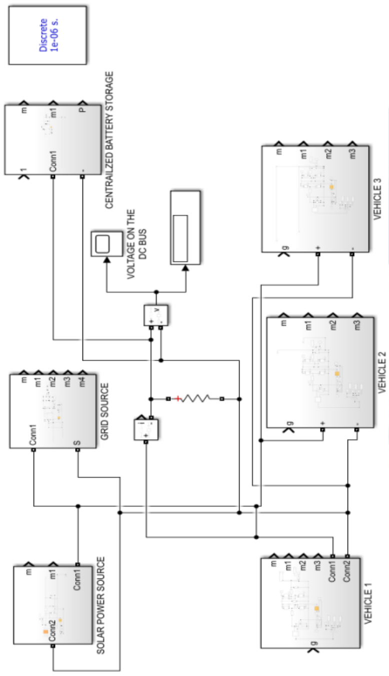

FIG 4. CHARGING SIMULATION FOR VARIOUS BUSES

b)Solar power source

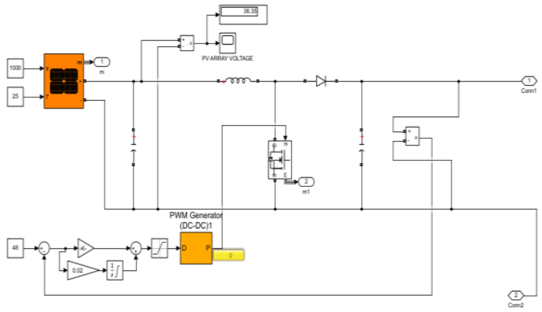

FIG 5. SOLAR POWER SOURCE

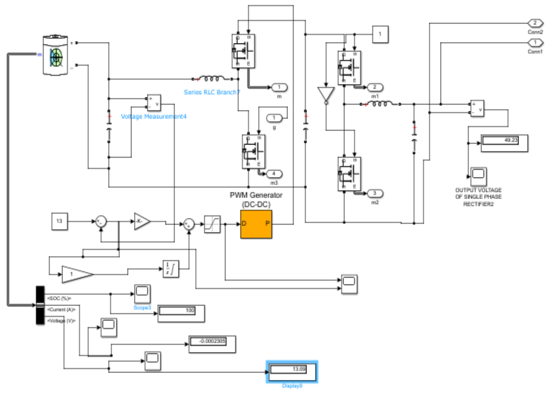

FIG 6 VEHICLE

Here, DC to DC Bidirectional battery charging circuit involves both charging and discharging process, when the power flow is from vehicle to Grid operation is termed as unidirectional, when the battery is dried, charging is needed at that time power flow is from Grid to vehicle, charging and discharging level is optimized by their SOC level

d) Centralized Battery source

The circuit involves additional source battery charging and supply to DC Grid. Battery charging circuit involves unidirectional control that makes the battery as a source to make a stability 0f 48V .

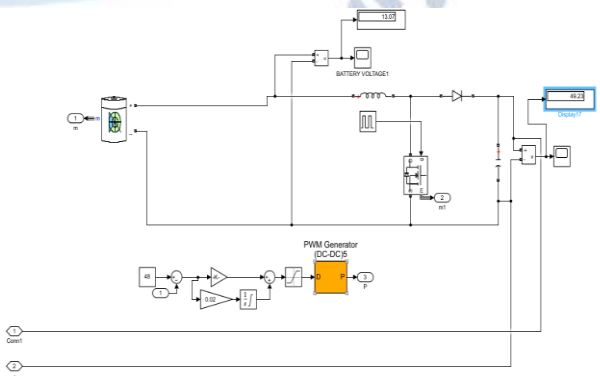

FIG.7 CENTRALISED BATTERY SOURCE

e) Grid source

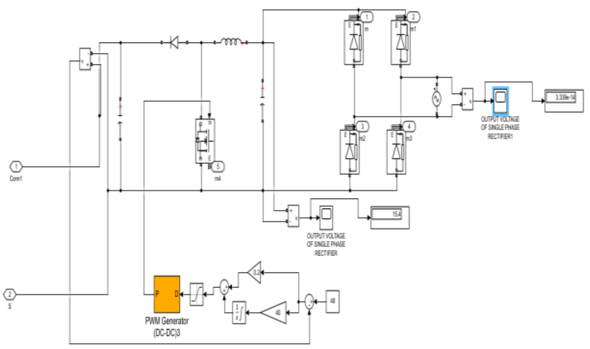

FIG .8 GRID SOURCE

The above circuit talks about other significant sources AC source and corrected to Converter block rationale, converter help the DC Grid voltage and ventured into battery charging circuit.

Description

The beams from the sun are met by a raised focal point over the AC Supply Energy sensor. The cooling framework gives the tem-perature contrast in the AC Supply Energy. By Charging and Dis-charging impact the voltage is created and it is buck or supported by buck help converter. The battery stores this voltage. Through the inverter the apparatuses take the inventory voltage. The AC Supply Energy plate changes over heat energy into electrical energy utilizing the Charging and Discharging impact.

While giving intensity to the AC Supply Energy plate at one side of the plate gets hot and at the opposite side of the plate gets cold implies that the temperature of the two finishes is different is known as the Charging and Discharging impact. The result of the both sun based and AC Supply Energy plate is associated with the battery through the charging circuit. The charging circuit capabilities as a voltage controller, for example the most common way of switching variable voltage over completely to steady managed voltage.

The fundamental capability of a regulator is to keep the battery from being cheated by the half breed framework. At the point when a battery is completely energized, the regulator will either stop or dial back how much current streaming into the battery from the creating frameworks. Battery can be utilized for stockpiling purposes. Subsequently this half breed framework will work at day time as well as at evening.

The result of the battery is DC that can be straightforwardly connected to any DC load. Move the slide switch that is available on the charging circuit board to run the DC engine. The result of the battery is DC just, for required AC ability to change over from DC to AC structure. The inverter is utilized for switching DC over completely to AC and the battery is associated with an inverter board to change over created DC into AC voltage. The beat generator creates beats and is given to the MOSFET. This should be possible in a voltage source inverter circuit

This inverter board takes DC input from the battery and converts it to A move forward transformer is introduced to get low voltage from two MOSFETs and the transformer will move forward the voltage The transformer high voltage for example auxiliary side is associated with the AC apparatuses for example AC engine.

AC SUPPLY ENERGY SENSOR

According to the Charging and Discharging effect the sensor converts the temperature difference into electricity by the flow of electrons.

BOOST CONVERTER

The boost converter is a DC-Dc converter, which either step up or step down the voltage. Based on the trigger signal from the controller the gate of the Quadratic boost converter is driven and the respective operation is performed.

BATTERY

Generally we use Lead acid battery as inverter battery. This battery can be used to store the electrical energy produced by the sensor. The stored energy can be utilized at any time.

The controller controls the duty cycle of the Quadratic Boost converter. The feedback from the Quadratic Boost converter *is* given to the controller. It checks the feedback value with reference value and the respective control signal is generated. And gives a steady output which can be stored in the battery.

PWM INVERTER

Pulse Width Modulation is used in inverters to give a steady output voltage of 230 V AC respective of the load. The inverters based on the PWM technology are more superior to the conventional inverters. The use of IGBTs in the output stage and the PWM technology makes these inverters ideal for all types of loads. In addition with PWM additional circuits for protection and voltage control.

BOOST CONVERTER

The buck support converter is a sort of DC-to-DC converter that has a result voltage size that is either more noteworthy than or not exactly the information voltage extent. This comprises two geographies of buck and boost. The result voltage extent relies upon the duty cycle. This converter is otherwise called a move forward or venture down transformer.

WORKING OF BOOST CONVERTER

The working operation of the DC to DC converter is that the inductor in theinputresistancehasanunexpectedvariationintheinput current.Iftheswitch is ON then the inductor feeds the energy from the input and it stores the energy of magnetic energy. If the switch is closed it discharges the energy. The output circuit of the capacitor is assumed to be sufficiently high sufficient that the time constant of an RC circuit is high on the output stage. The huge time constant is compared with the switching period and makes sure that the steady state is a constant output voltage Vo(t)=Vo(constant) and present at the load terminal.

WORKING OF BOOST CONVERTER

The transformer is a static electrical equipment which transforms electrical energy to magnetic energy and again to electrical energy. The operating frequency and nominal powered approximately equal on primary and secondary transformers is a very difficult equipment. While the voltages and currents are usually different. Essentially , the main task of this is converting high voltage (HV) and low current.

Discharging of vehicles

The three various vehicles considered which are to be considered to get discharged by the various three vehicles 1, 2, 3statesthesoclevelis100%.The vehicles considered are charged by the three sources - solar voltage source, grid source and centralized battery sources to optimize the voltage of 48V.

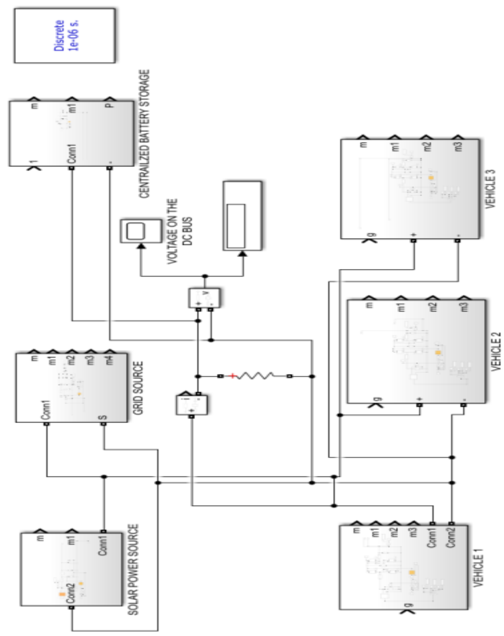

FIG 10 DISCHARGING MODEL

5. DISCUSSIONS AND ANALYSIS

SOC of Vehicles	Threshold	Charge% In Battery At Time T0	Battery Charging Status		
			At Time T0	At Time T1	At Time T3
SOC of Vehicle 1	30%	0%	0% / Charging	60% / Discharging	40% / Discharging
SOC of Vehicle 2	30%	35%	35% / Discharging	10% / Charging	25% / Charging
SOC of Vehicle 3	30%	65%	65% /Discharging	40% / Discharging	20% / Charging

TABLE 1 Charging and Discharging Status of Vehicles

The various vehicles namely vehicle 1, vehicle 2, and vehicle 3 with the various soc levels as 0%, 35% and 65% are considered . As the threshold at the grid voltage is set at 30%, priority of charging the vehicles changes accordingly to the SOC levels. AT the initialtimeT0afterthevehiclesattherest,vehicle1 SOC level is lower than the threshold percentage, sothepriorityofchargingoestovehicle1 by getting the charges discharging from vehicle 2 and vehicle 3.

After a certain duration of time T1 ,vehicle 2 attains the threshold percentage which statesvehicle2 to be charged by the charges discharging from vehicle 1 and vehicle 3 . Finally, after a certain time T2, vehicle 3 gradually attains the threshold percentage and gets charged by the discharging taking place from vehicle 1 and vehicle 2.

GRID VOLTAGE

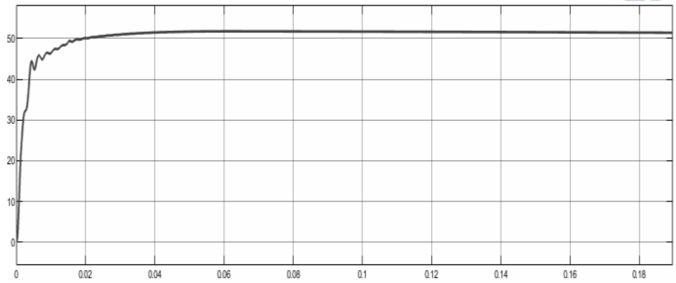

FIGURE 11. Graph of voltage on the bus voltage and time

The above graph shows the optimized steady state DC voltage 48V , to maintain a DC Grid. Here Split Pi optimization Pulse technique enables a pulses to switch with a high frequency logic amplifying circuit.

SOC LEVEL MODULATION

CHARGING STATE VEHICLE 1:

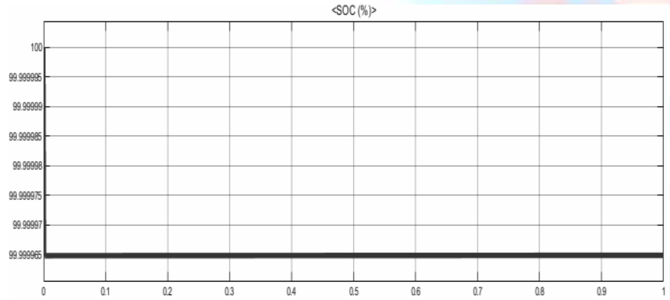

FIGURE 12 SOC level of vehicle 1

TABLE 2. CHARGING STATE OF VEHICLE 1

VEHICLE NO.	THRESHOLD In %	CHARGE IN %	SOC OF VEHICLE 1 At time T0	SOC OF VEHICLE 2 At time T1	SOC OF VEHICLE 3 At time T2
VEHICLES 2	30%	35%	35% / discharging	10% / charging	25% / discharging

Here, the SOC level for battery optimization is shown. The above figure shows the battery is in dry state, needs to charge 100% or the charging state is called zero

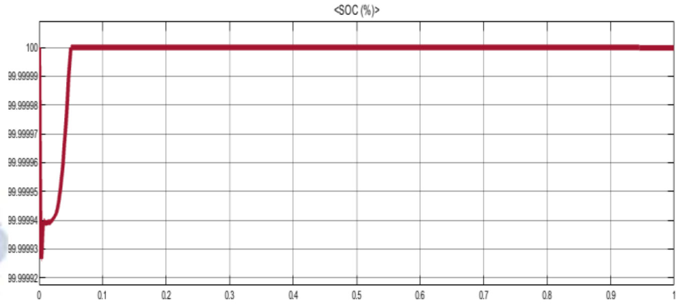

FIGURE 13 DISCHARGING SOC LEVEL OF VEHICLE 2 AND 3

When vehicle 1 reaches the threshold percentage, vehicle 1 gets charged by discharging from vehicle 2 with the charge of 35% and from vehicle 3 with the charge of 65%.

CHARGING STATE VEHICLE 2:

TABLE 3. CHARGING STATE OF VEHICLE 2

VEHICLE NO.	THRESHOLD In %	CHARGE IN %	SOC OF VEHICLE 1 At time T0	SOC OF VEHICLE 2 At time T1	SOC OF VEHICLE 3 At time T2
VEHICLES 1	30%	0%	0% / charging	60% / discharging	40% / discharging

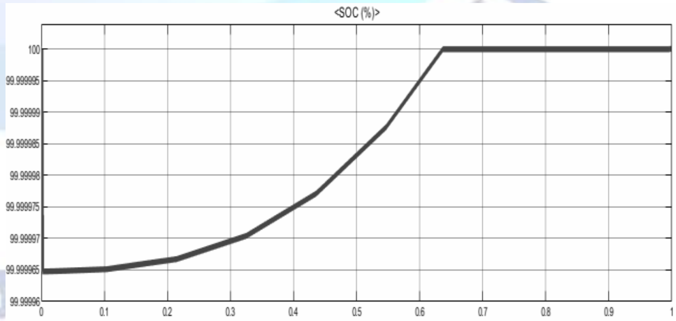

FIGURE 14 SOC LEVEL OF VEHICLE 2

Here, the SOC level for battery optimization is shown. The above figure shows the battery needs to charge and 35% charging state.

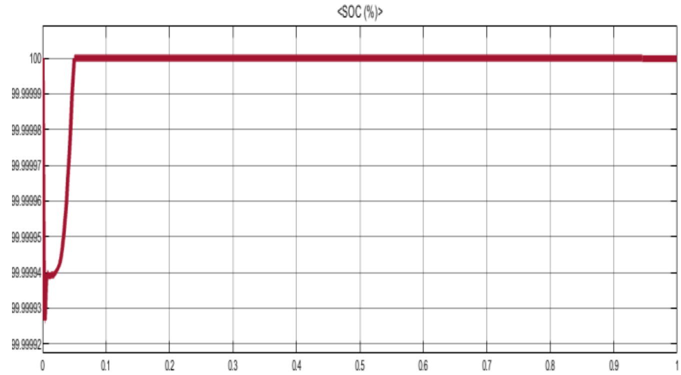

FIGURE 15 DISCHARGING SOC LEVEL OF VEHICLE 1 AND 3

When vehicle 2 reaches the threshold percentage ,vehicle 2 gets charged by discharging from vehicle 1 with the charge of 35% and from vehicle 3 with the charge of 65%.

CHARGING STATE VEHICLE 3:

VEHICLE NO.	THRESHOLD In %	CHARGE % IN BATTERY	SOC OF VEHICLE 1 At time T0	SOC OF VEHICLE 2 At time T1	SOC OF VEHICLE 3 At time T2
VEHICLES 3	30%	35%	35% / discharging	10% / charging	25% / discharging

TABLE 4. CHARGING STATE OF VEHICLE 3

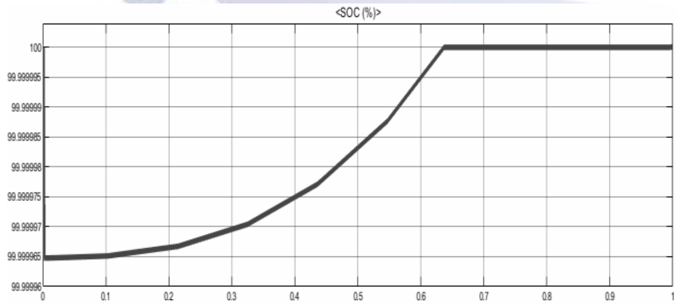

FIGURE 16 SOC LEVEL OF VEHICLE 3

Here, the SOC level for battery optimization is shown. The above figure shows the battery needs to charge and 65% charging state.

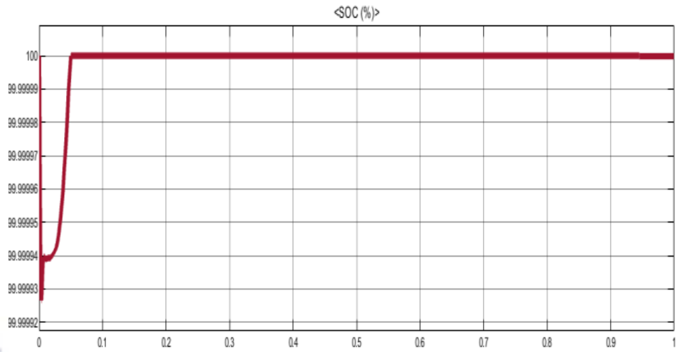

FIGURE 17 DISCHARGING SOC LEVEL OF VEHICLE 1 AND 2

When vehicle 3 reaches the threshold percentage, vehicle 1 gets charged by discharging from vehicle 1 with the charge of 35% and from vehicle 2 with the charge of 65%.

6. CONCLUSION

As the use of electric vehicles is increasing day by day, their charging system must be robust and reliable so that one can use electric vehicles without any problem. The paper presents conductive AC charging conventions for charging the module cross breed electric vehicles. In this, hypothesis of conductive charging is researched and complete examination of the on-board charger is finished because of which one ought to have the option to confirm the legitimate states for the beginning of charging and the scope of most extreme flow not entirely settled by the obligation cycle. This paper demonstrates the way that one can plan a conductive charging framework according to car industry Standards. To tackle the issue of energy accessibility in DC transports should be possible by utilizing a model of battery unit capacity framework. The energy wellspring of the PV cluster and AC lattice, independently

Conflict of interest statement

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

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