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RESEARCH ARTICLE OPEN ACCESS

Photovoltaic Power Charging Station Simulation for Electric Vehicles

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Abstract—
With the development and widespread use of electric vehicles, environmental concerns and rising gasoline prices have emerged. The aggressive promotion of electric vehicle chargers will negatively impact the power quality of the power system because they are a usual high power nonlinear device. Electric car chargers use power electronic technology. Therefore, this is a significant issue that must be taken into account when building a recharge station. Before building an electric car charging station, engineers must assess and model the effect the station and its functioning will have on the grid. Engineers must also be aware of whether national standards are met in terms of charging station building requirements. In order to determine whether suitable administration, such as harmonic suppression and reactive power correction devices, need to be configured at charging stations, the findings of analysis and models can serve as a reference during the building of charging stations. The article's primary focus is on the PV array, charger, and charging station elements of a modelling study of a photovoltaic electric car charging station. Then it describes how to model and analyse data using MATLAB modelling software.
Index Terms - Electric Vehicle, Photo-Voltaic, MATLAB, Charger.

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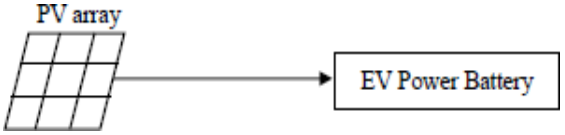
I. INTRODUCTION

With the ceaseless advancement of charging vehicle, the quantity of electric vehicles is expanding. So energy utilization of charging and releasing organization which electric vehicle charging offices framed will be exceptionally enormous. Hence the effect on the framework is additionally progressively can't be disregarded. According to one viewpoint, the actual charging burden for electric vehicles is somewhat random. There is a need to increase the power lattice maximum because that could lead to an increase in the peak power demand. Some organisations that transmit and distribute electric power refuse to send their energy requirements. However, the symphony that electric car charging equipment produced will also have an impact on the local force network. The proper completion of the design of the electric vehicle charging station and the quantitative analysis of the enormous energy utilisation influences that the foundation network brought have thus become the focus of many power workers due to the widespread application potential of electric vehicles.

So that the growth of the electric vehicle charging and releasing offices won't affect the regular operation of the force framework, to make the design of the electric vehicle charging and releasing offices more rational and levelheaded. It should be intensely and completely focused on the strategy and the leaders' use of energy.

There are several possible ways for photo-voltaic (p-v) to charge electric vehicles. The energy distribution ways shows as followed figure. The series of steps will prepare an overview of the systems components, complete system efficiency in keeping with pre-determined input parameters and several ways of classification of Energy from Photovoltaic to Charging Station. The block-diagram of the EV PV public charging station is presented in figure 1.



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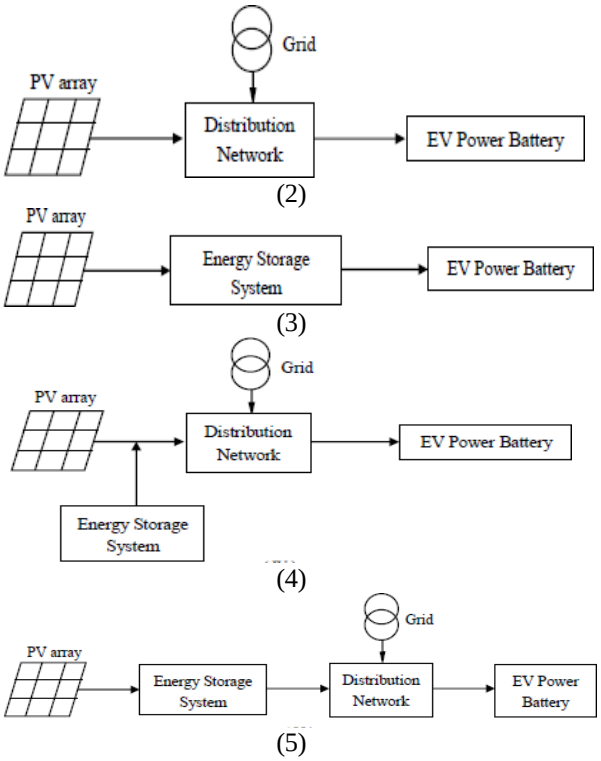
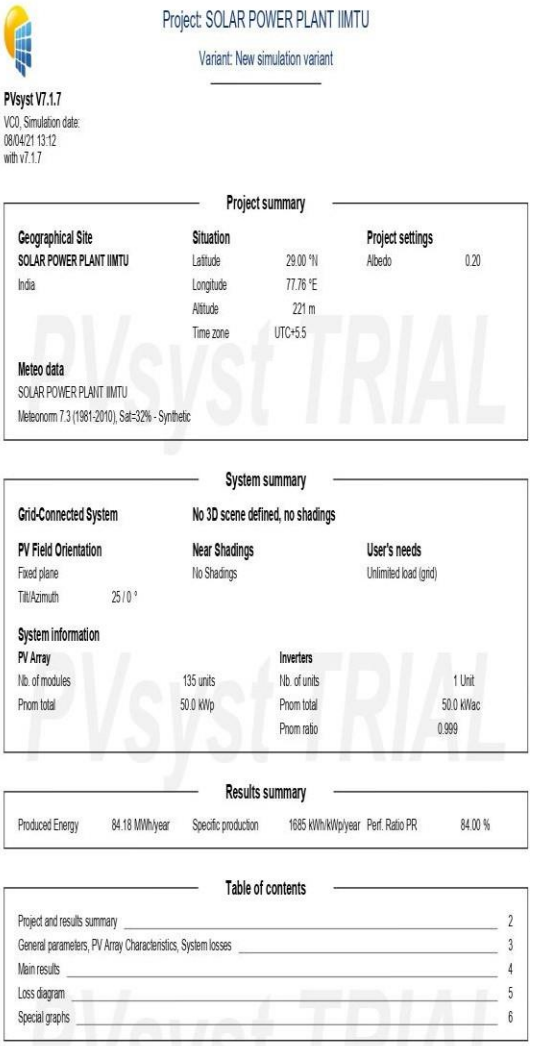


Fig1:- Modes Classification of Energy from Photovoltaic to Charging Station

II. PV SYSTEM Design

To evaluate the power and energy generated by a 50 kWp PV array in the India, an accurate measurement of weather data is required. For this purpose, the meteorological data from the MITEONORM is used, which has a resolution of 1 min. Global horizontal irradiance (SGHI), Diffuse Horizontal Irradiance (SDHI), Direct Normal Irradiance (SDNI) and ambient temperature (Ta) are obtained from MITEONORM for the years 2020. A 50 kWp PV array was modeled in MATLAB using 135 modules of VIKRAM SOMERA vsm370 modules rated at 370W. They are connected in 9 parallel strings having 15 modules in series having a combined installed power of 49950 W.


Project: SOLAR POWER PLANT IIMTU

Variant: New simulation variant

PVsyst V7.1.7
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Project summary

Geographical Site	Situation		Project settings	
SOLAR POWER PLANT IIMTU	Latitude	29.00 °N	Albedo	0.20
India	Longitude	77.76 °E		
	Altitude	221 m		
	Time zone	UTC+5.5		

Meteo data
SOLAR POWER PLANT IIMTU
Meteonorm 7.3 (1981-2010), Sat=32% - Synthetic

System summary

Grid-Connected System	No 3D scene defined, no shadings	
PV Field Orientation	**Near Shadings**	**User's needs**
Fixed plane	No Shadings	Unlimited load (grid)
Tilt/Azimuth 25 / 0 °		

System information

PV Array		Inverters	
Nb. of modules	135 units	Nb. of units	1 Unit
Pnom total	50.0 kWp	Pnom total	50.0 kWac
		Pnom ratio	0.999

Results summary

Produced Energy 84.18 MWh/year Specific production 1685 kWh/kWp/year Perf. Ratio PR 84.00 %

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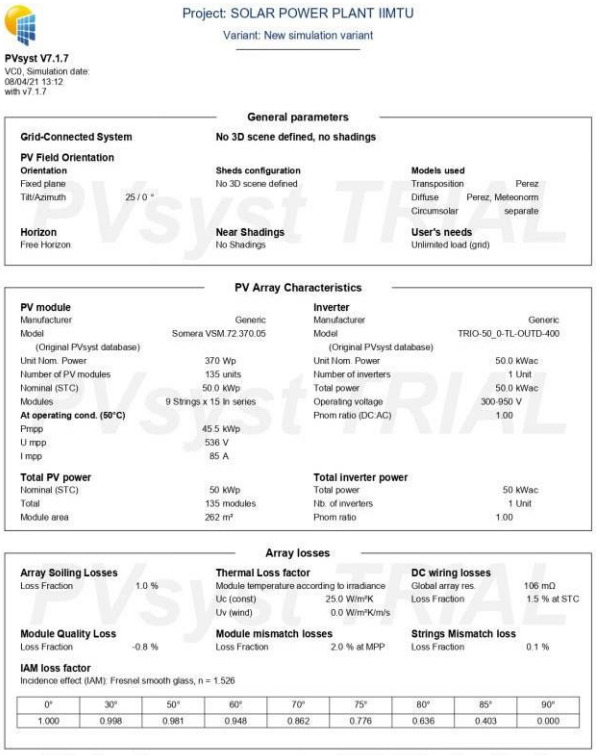

Project: SOLAR POWER PLANT IIMTU
Variant: New simulation variant

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with v7.1.7

General parameters

Grid-Connected System	**No 3D scene defined, no shadings**	
PV Field Orientation		
Orientation	**Sheds configuration**	**Models used**
Fixed plane	No 3D scene defined	Transposition Perez
Tilt/Azimuth 25 / 0 °		Diffuse Perez, Meteonorm
		Circumsolar separate
Horizon	**Near Shadings**	**User's needs**
Free Horizon	No Shadings	Unlimited load (grid)

PV Array Characteristics

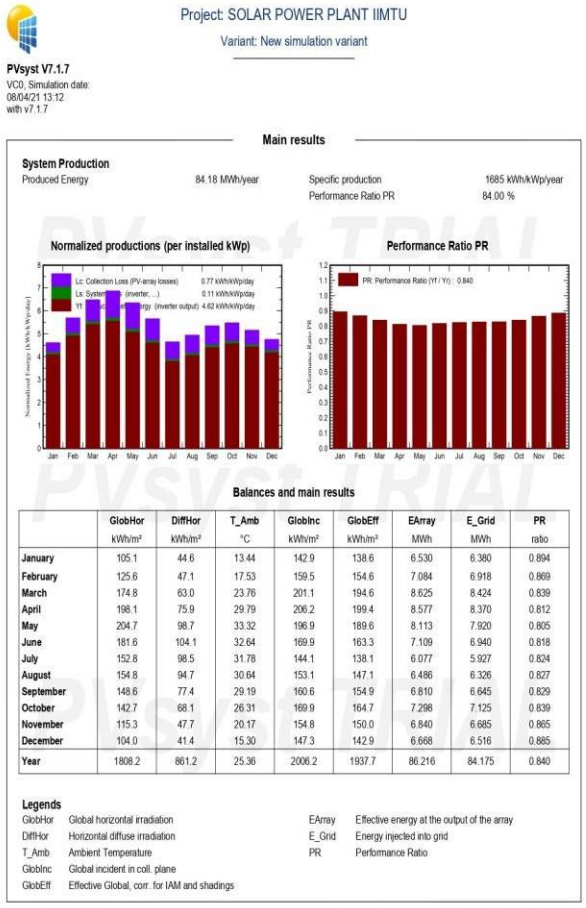
PV module		**Inverter**	
Manufacturer	Generic	Manufacturer	Generic
Model	Somera VSM.72.370.05	Model	TRIO-50_0-TL-OUTD-400
(Original PVsyst database)		(Original PVsyst database)	
Unit Nom. Power	370 Wp	Unit Nom. Power	50.0 kWac
Number of PV modules	135 units	Number of inverters	1 Unit
Nominal (STC)	50.0 kWp	Total power	50.0 kWac
Modules	9 Strings x 15 In series	Operating voltage	300-950 V
At operating cond. (50°C)		Pnom ratio (DC:AC)	1.00
Pmpp	45.5 kWp		
U mpp	536 V		
I mpp	85 A		
Total PV power		**Total inverter power**	
Nominal (STC)	50 kWp	Total power	50 kWac
Total	135 modules	Nb. of inverters	1 Unit
Module area	262 m²	Pnom ratio	1.00

Array losses

Array Soiling Losses	**Thermal Loss factor**	**DC wiring losses**
Loss Fraction 1.0 %	Module temperature according to irradiance	Global array res. 106 mΩ
	Uc (const) 25.0 W/m²K	Loss Fraction 1.5 % at STC
	Uv (wind) 0.0 W/m²K/m/s	
Module Quality Loss	**Module mismatch losses**	**Strings Mismatch loss**
Loss Fraction -0.8 %	Loss Fraction 2.0 % at MPP	Loss Fraction 0.1 %

IAM loss factor
Incidence effect (IAM): Fresnel smooth glass, n = 1.526

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.998	0.981	0.948	0.862	0.776	0.636	0.403	0.000



Project: SOLAR POWER PLANT IIMTU
Variant: New simulation variant

PVsyst V7.1.7
VC0, Simulation date: 08/04/21 13:12
with v7.1.7

Main results

System Production
Produced Energy 84.18 MWh/year
Specific production 1685 kWh/kWp/year
Performance Ratio PR 84.00 %

Normalized productions (per installed kWp)

Performance Ratio PR

Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR ratio
January	105.1	44.6	13.44	142.9	138.6	6.530	6.380	0.894
February	125.6	47.1	17.53	159.5	154.6	7.084	6.918	0.869
March	174.8	63.0	23.76	201.1	194.6	8.625	8.424	0.839
April	198.1	75.9	29.79	206.2	199.4	8.577	8.370	0.812
May	204.7	98.7	33.32	196.9	189.6	8.113	7.920	0.805
June	181.6	104.1	32.64	169.9	163.3	7.109	6.940	0.818
July	152.8	98.5	31.78	144.1	138.1	6.077	5.927	0.824
August	154.8	94.7	30.64	153.1	147.1	6.486	6.326	0.827
September	148.6	77.4	29.19	160.6	154.9	6.810	6.645	0.829
October	142.7	68.1	26.31	169.9	164.7	7.298	7.125	0.839
November	115.3	47.7	20.17	154.8	150.0	6.840	6.685	0.865
December	104.0	41.4	15.30	147.3	142.9	6.668	6.516	0.885
Year	1808.2	861.2	25.36	2006.2	1937.7	86.216	84.175	0.840

Legends

GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		

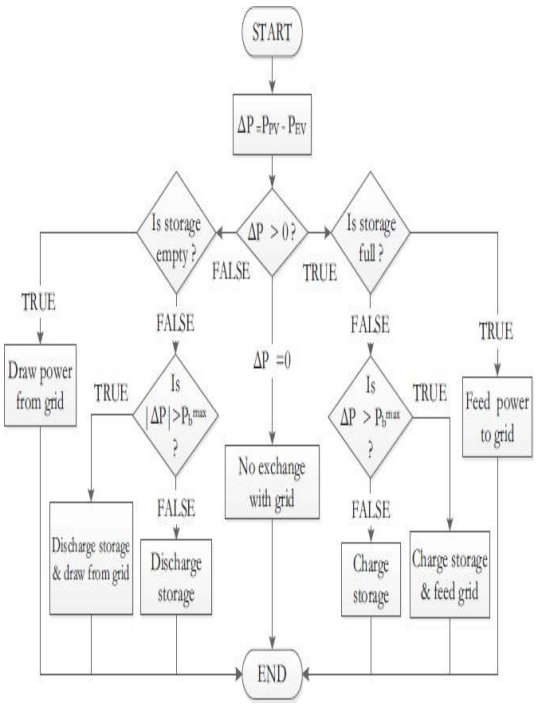


Fig2:- State diagram for operation of EV–PV charger with local storage.

A. Integrating local storage in EV–PV charger

III. Simulation of Photo-Voltaic Power Charging Station

The aggressive promotion of electric vehicle chargers will negatively impact the power quality of the power infrastructure because they are a typical high power nonlinear device and use power electronic technology. Therefore, this is a significant issue that must be taken into account when building a recharge station. Before building an electric car charging station, engineers must assess and model the effect the station and its functioning will have on the grid. Engineers must also be aware of whether national standards are met in terms of charging station building requirements. In order to determine whether suitable administration, such as harmonic suppression and reactive power correction devices, need to be configured at charging stations, the findings of analysis and models can serve as a reference during the building of charging stations.

The article's primary focus is on the PV array, charger, and charging station to illustrate the modelling study of a photovoltaic electric car charging station. Then it describes how to model and analyse data using MATLAB modelling software.

A. PV ARRAY

For any given temperature and radiation parameters, PV array model equation can be determined according to I-V curve of the PV cells. PV array modeling process is as shown in the figure below.

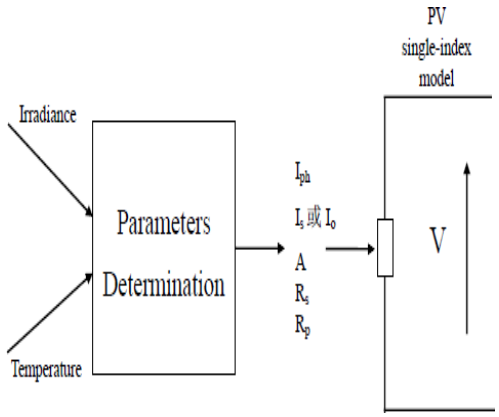


Fig3:- PV Modeling Procedure

B. CHARGING SET

Hf charger general structure diagram is as follows. Among them, three-phase alternating current (ac) Ua, Ub, Uc are obtained through transformer from the three-phase grid. They can provide power for charger. High frequency DC to DC converter frequency is more than 20 kHz. Here, as well as having isolation effect, it can reduce the volume of equipment such as transformer and filter. At the mean time
,it can also improve the filtering effect and efficiency of charger.

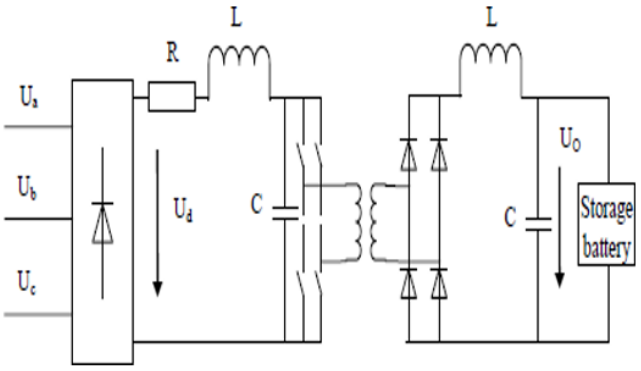


Fig4:- Hf Charger General Structure Diagram

IV. MALAB simulation and Results

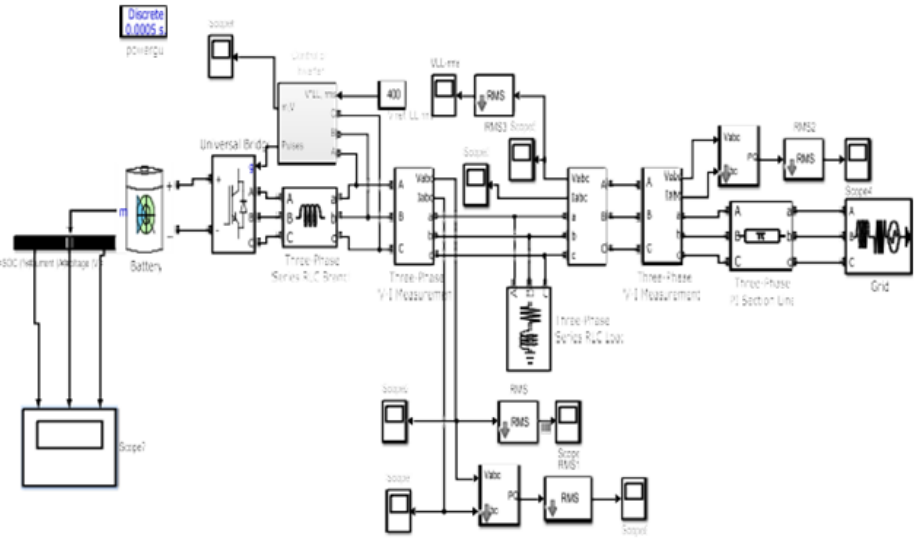


Fig5. Simulation of grid connected battery

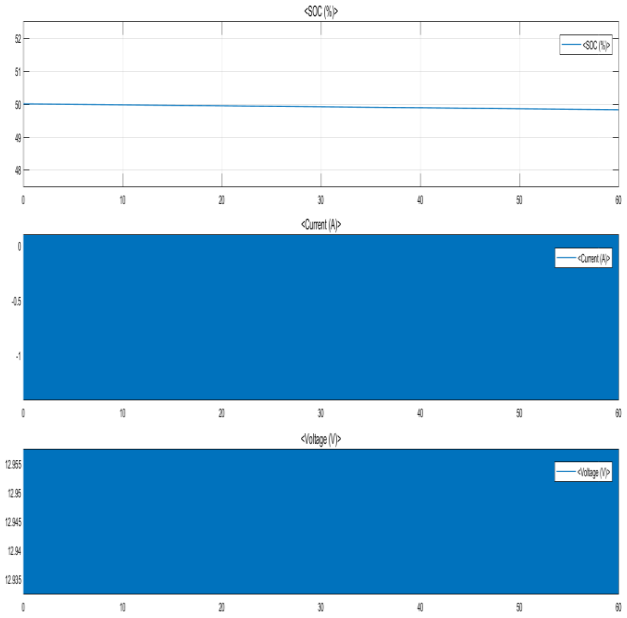


Fig6. Battery Discharging

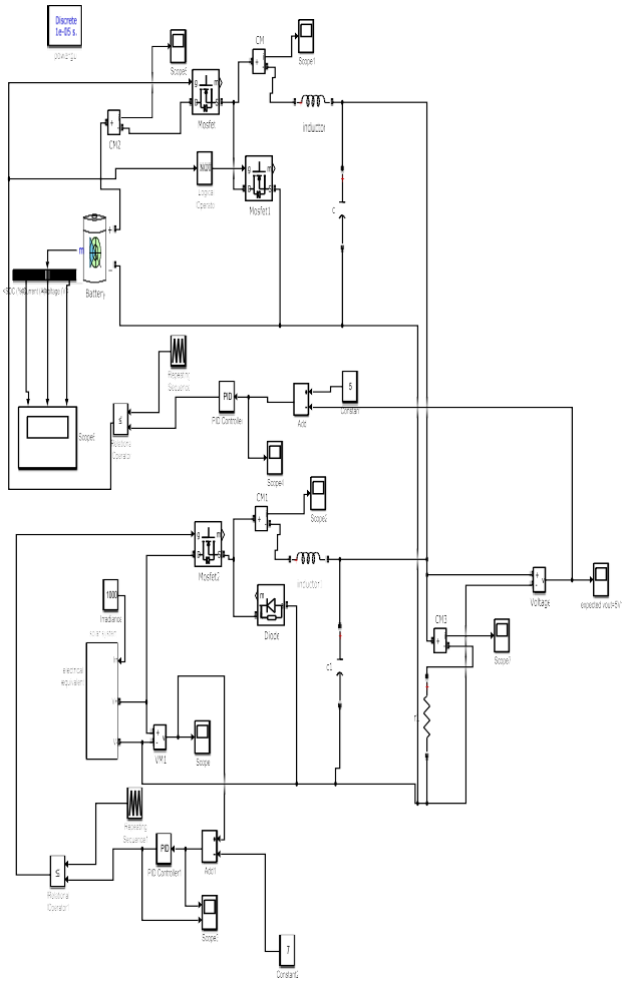


Fig7. Simulation of solar PV and battery charging

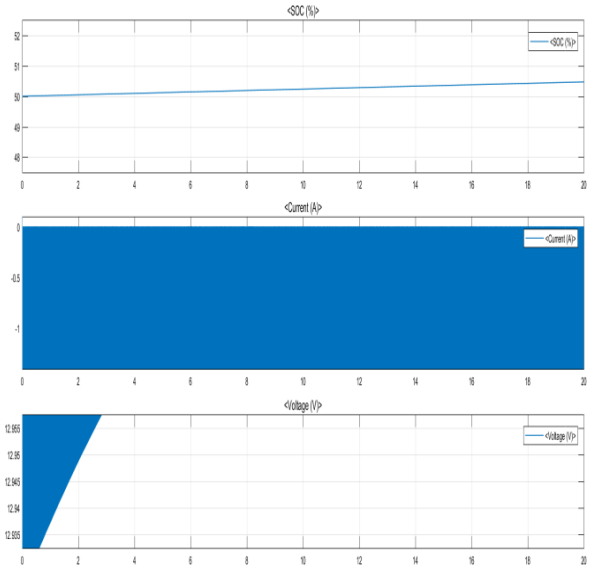


Fig8. Battery charging for 20 second (SOC: 50 to 50.5)

V. CONCLUSION

Charging electric vehicles at work using solar energy provides a feasible transition to mobility later. It encourages solar-powered building roofs and provides instant PV power consumption during the day. Electric car charging facilities should also serve as an interface between the electric vehicle and the larger structure. Therefore, the growth of electric vehicle recharge stations is the entrance to the manufacturing of electric vehicles. The proposal uses the electric vehicle charging stations with photovoltaic power source as a model for looking at the design, recreation, and study of the charging station. The proposal is based on two headings: photovoltaic and electric vehicle charging stations. The article outlines the basic layout of two different types of charging stations and emphasises the necessity of practising the charging station action in advance using MATLAB/Simulink programming. That will bode well before development of the charging station real, making the charging station more helpful, arranging and sensible.

Sustainable power is clarified with its different Equipment utilized in station design . The management method used in bidirectional inverters is also demonstrated in the article for proper downplaying. The station uses a sun-oriented PV system for both practical and financial reasons, while backup batteries provide power for the station's top long periods of time, reducing the weight of the lattice and allowing for the trading of battery capacity. In order to examine and grasp the accusing rate behaviour of their particular synthesis, the charging of EVs is efficiently handled with their result dealt with a variety of battery types.

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