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"GRID CONNECTED ELECTRIC VEHICLE CHARGE STATION WITH MULTI RENEWABLE SOURCE"

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Abstract: In this paper the battery of one or multiple electrical vehicles are charged when connected to conventional three phase grid through controlled rectifier and DC-DC converter. The conventional grid is integrated with multiple renewable sources which include PVA and wind farm. The battery charges utilizing maximum power from the aforementioned renewable sources. During deficit renewable power conditions three phase grid provides power for battery to charge through rectifier. The energy management control structure for the test system including grid with domestic loads, EV charging station, renewable sources is modeled. Different operating conditions with variable environmental factors impacting the renewable sources and EV battery charging are analyzed using MATLAB Simulink software. Graphical representation with time as reference is done using 'powergui' toolbox.

Index Term: PVA (Photo Voltaic Array), EV (Electric vehicle), MATLAB (Matrix Laboratory), Simulink, powergui (Power graphical user interface).

I. INTRODUCTION

increase in climatic disasters throughout the globe year by year, global warming is now considered to be the biggest issue to be taken care of. With further increase in these disasters may lead to extinction of human life and also other living beings. The major reasons behind global warming is generation of power from conventional methods using coal, diesel or any other fossil fuels and also increase As in the proposed test system the grid is connected in parallel with renewable energy power sources feeding power to the EV battery charging station [5]. Along with the sources a energy storage module is also connected though AC-DC converter to store excess power generated from the renewable sources. In this paper section I is discussion about the proposed test system with multiple module connections followed by section II with renewable sources configuration. In section III multiple converters used for the AC-DC or DC-DC conversion are defined. The simulation of the complete test system with all the modules connected and results generated are given in section IV. The final section V includes conclusion to the paper followed byreferences.

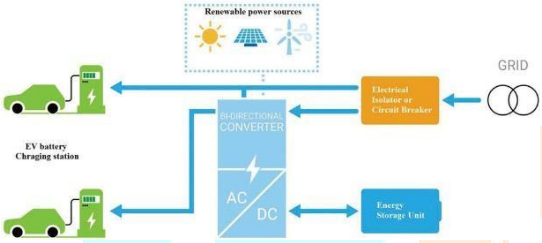


Fig: **Proposed test systemwith renewable sources and EV battery charging station**

II LITERATURE REVIEW:

[1] H. H. El-Tamal et. al.This paper introduces a complete simulation program for optimal design of a hybrid photovoltaic wind energy system, PVWES, to be interconnected with utility grid, UG. A computer program has been designed to determine optimum number of PV modules and optimum number of wind turbine generator, WTG based on maximum power point by using neural network for the system under study. Many WTG and PV types have been introduced to computer program to choose the best type and the penetration ratio for WTG and PV modules. The computer program can completely design the hybrid system and determine the hourly system parameters as power flow, frequency of output power form WTG, and DC output voltage from PV modules. The decision from the computer program is based on minimum price of the generated kWh from the system. The system show the superiority of using hybrid PVWES.

[2] Hang-Seok Choi, ET. Al. This paper presents a new zero current switching (ZCS) inverter for grid-connected photovoltaic system. The proposed circuit provides zero current switching condition for all the switches, which reduces switching losses significantly. It is controlled to extract maximum power from the solar array and to provide sinusoidal current into the mains. Analysis, small signal modeling and design system is verified by experimental results from the 1.2 kW prototype inverter operating at 40 kHz.

[3] Kim Johnsen, and Bo Eliasson proposes that modeling of a PV-wind hybrid system in Matlab/Simulink. The model is useful for simulation of a hybrid PV-wind system connected to a grid. Blocks like wind model, PV model, energy conversion and load are implemented and the results of simulation are also presented. The behavior of hybrid system employing renewable and variable in time energy sources while providing a continuous supply. Application represents a useful tool in research activity and also in teaching. [4] Florin Iov et al. proposes that as wind turbine technology and control has advanced over the last decade, this has led to a high penetration of wind turbines into the power system. Whether it be for a large wind turbine or an offshore wind farm with hundreds of MW power capacity, the electrical system has become more and more important in controlling the interaction between the mechanical system of the wind turbine and the main power system. The presence of power electronics in wind turbines improves their controllability with respect not only to its mechanical loads but also to its power quality

[1] . This paper presents an overview of a developed simulation platform for the modeling, design and optimization of wind turbines. The ability to simulate the dynamic behavior of wind turbines and the wind turbine grid interaction using four simulation tools (Matlab, Saber, Dig SILENT and HAWC) is investigated, improved and extended.

III DISCRIPTION OF SYSTEM (RENEWABLE ENERGY SOURCE):

As previously mentioned the proposed test system is included with two renewable sources which are PVA (solar panel) Renewable energy source is one of the prime energies among the other sources in the non-conventional energy sources, which is always replenished by natural resources. Some of the energies such as solar energy, bio-energy, wind energy, etc. are examples of renewable energy resources. Renewable energy system converts the solar, wind, falling-water, sea- waves, geothermal heat or biomass energy into useful form of heat or electricity. The majority of renewable energy is solar energy and it comes either directly or indirectly from the sun and they never get depleted. Hence, they are called as renewable energy. Most of the world's energy requirements are met from non-renewable energy sources such as fossil fuels such as coal, natural gases, and oil. They have been proven to be highly effective drivers of economic progress. But at the same time, they damage the environment and human health due to its pollution. In spite of having more non-renewable energy due to decrease in the stock of fossil fuels day by day, they will get exhausted after a few years. Hence the demand for renewable energy sources has increased as it is environmental friendly, pollution-free, and reduces the greenhouse effect. As per the International Energy Agency, it is forecasted to have 35 percentage of total energy produced across the globe from PV sources by the year 2050.

Eventually, by then, solar energy would be the largest source of energy in the world. Due to the intensive research, solar energy is day by day becoming more accessible and very economic, zero carbon emission technology to utilize renewable energy from the Sun. This section mainly describes the modeling of Photovoltaic array, MPPT and DC-DC boost converter for generating required voltage as per the MG system.

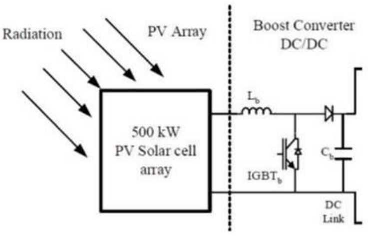
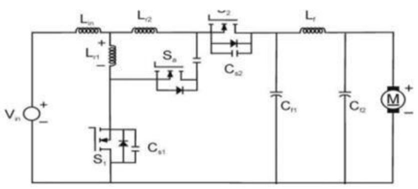
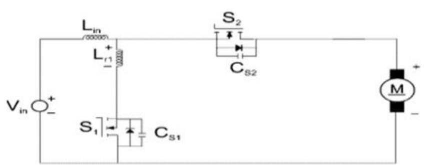


Fig:pva connection to boost converter

III NON-ISOLATED DC-DC CONVERTER

Non-isolated DC-DC converter is suitable for medium and high power applications. Power electronics converter systems for application such as telecom, automotive and space craft can have DC voltage buses that are backed up with batteries or super capacitors. These batteries or super capacitors (Stephan Kenzelmann et al. 2015) connected to the buses with bidirectional DC-DC converter that allows them to be discharged or charged depending on the operating conditions (Pritam Das et al.2010).The non-isolated bidirectional DC-DC converter is shown in Figure 4.1. The circuit consists of two main switches, auxiliary switches, three inductors, ʌ filter and DC motor. The two main switches are operated alternatively. Switch S1 operates like a boost mode switch and S2 operates like a buck mode. Current flows through the Inductor Lin in both directions during each switching cycle (KrzysztofrGorecki 2009). The four components such as auxiliary switches, capacitor Cr and inductorLr1and Lr2 make- up a simple circuit that is based on well-established active clamp (Bhat 1995) technology,Non-isolated bidirectional converter is used for charging and discharging, depending on the operating condition. This converter can be operated in either buck or boost mode (Esam H Ismail 2009). The proposed non-isolated bidirectional DC-DC converter is compared at the load side of C, LC and ʌfilter to produce the ripple content of each filter.





Fig(a): **Standard non-isolated bidirectional converter fed dc motor**

Fig(b): **Non-isolated DC-DC converter fed DC motor**

At turn-on and turn off-period, PWM operates at constant frequency, there is current stress on the main switch, so there is no additional conduction losses (Esam H Ismail (2008),. The ZVS approach is applied in majority of the semiconductor devices such as MOSFETs, when being implemented as the input inverters, (Pritam Das et al. 2009)to reduce the switching losses and to increase the bidirectional energy conversion flexibility (Esteban Sanchis et al. 2011). The operation of the circuit is divided into seven modes.

IV BATTERY SYSTEM:

The battery stores electrical energy in form of chemical energy and the chemical energy again able to convert into electrical energy. The conversion of chemical energy to electrical energy is called discharging. The chemical reaction during discharge makes electrons flow through the external load connected at the terminals which causes the current flow in the reverse direction of the flow of the electron.Some batteries are capable to get these electrons back to the same electron by applying reverse current, This process is called charging. The capable batteries to get back electrons in the same electrode are called chargeable and if they are not capable to do this, are called non-rechargeable.

In a battery, the electrode where reduction occurs is called the cathode and where oxidation o.General battery diagram

There are three types of batteries in the market which are commonly used as rechargeable batteries.

- Lead-Acid batteries
- Ni-Cd batteries
- Ni-MH batteries
- Li-ion batteries
- Lead-Acid batteries

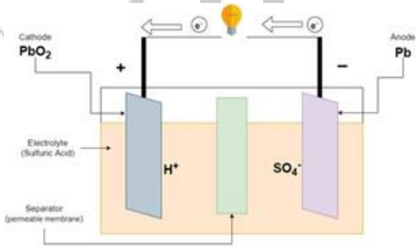


Fig: lead acid batteries

The lead-acid battery has a nominal voltage of about 2v, it can vary from 1.8v at loaded at full discharge to 2.40v in an open circuit at full charge. The calculation of charging voltage can be done with voltage 2.40v/cell. 12v lead acid battery can be made from 6 cells connected in series. The current capacity is totally dependent upon manufacturer and size, it can vary from approximately.

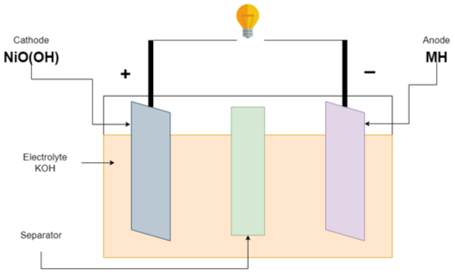


Fig: Ni-Cd batteries

Firstly, the Ni-Cd battery is invented in 1899 by WaldermarJungner. its positive electrode (Cathode) made of nickel oxide hydroxide (NiO(OH)), and a negative electrode (anode) made of Metallic cadmium (Cd). The electrolyte used is 30 percent potassium hydroxide (KOH) in distilled water. The electrolyte level maintained just above the top of the electrode. There are no appreciable changes that occur in the electrolyte during charging and discharging.

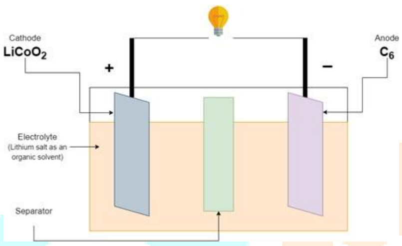


Fig: Ni-MH battery

Firstly, the Ni-MH battery is invented in 1967 by Battelle-Geneva Research Center. Then it introduced in 2005 by Sanyo, branded Eneloop. In this battery positive electrode (cathode) made of nickel oxide hydroxide and a negative electrode made of hydrogen-absorbing alloy (Metal hydride). The electrolyte used is potassium hydroxide (KOH) concentrated with distilled water.

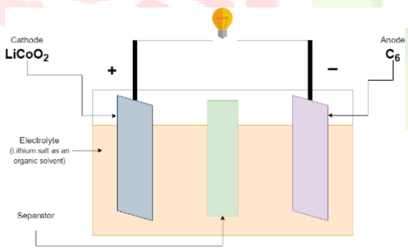


Fig: Li-ion battery

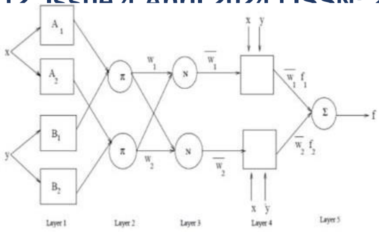
Firstly, a Lithium-ion battery was developed by Akira Yoshino in 1985. The positive electrode (cathode) is made of lithium cobalt oxide and the negative electrode (anode) is made of graphite. Lithium salt as an organic solvent is used as an electrolyte. A separator is used to separate electrodes.

hence aid in framework analysis. As a result, it is possible to anticipate and reproduce the framework's behavior. The framework model also aids in the planning of new cycles as well as the evaluation of existing ones. The framework model is used to design, develop, and oversee regulators, as well as to locate flaws and determine defective parts. This is because, in order to progress the framework's presentation, it is vital to successfully display the framework so that the model boundaries can be smoothed to obtain the required framework reaction. It is as a result of this fact that, in recent years, the presentation of largescale, complicated frameworks has piqued the curiosity of scientists of many orders all over the world. A major fraction of today's reality frameworks are poorly described in nature, making them difficult to demonstrate. The accuracy of the model is mostly responsible for the framework's presentation. As a result, it is critical to create a model that accurately reflects the behavior of the framework. The operation of complicated large-scale frameworks entails a number of tradeoffs, such as cost and precision. As a result, there is a strong desire to develop advanced tactics for framework showing and ID procedures. The traditional framework exhibiting tactics are heavily reliant on numerical instruments that require precise information about the complex actual cycles. In situations where a numerical model isn't available, it's unrealistic to expect to examine it using standard methods. In such instances, delicate processing-based displaying ways supply a viable option in contrast to the distinguishing proof of the framework from the available information. When LotfiZadeh was chipping away at the delicate investigation of information and airy rationale, the idea of delicate processing began to develop. This resulted in useful frameworks. The thought-provoking structure became a reality over forty years later. Nonetheless, the innovation essential for developing Artificial Intelligence (AI) frameworks was initially unavailable.

V ANIF CONTROLLER:

The vast majority of today's frameworks are huge and, by their very nature, unpredictable. Modern plants are substantially intricate in their design, including electrical power, synthetic, water purification, and similar vast reach. Elabashed frameworks can be direct or nonlinear, continuous or discrete, time-shifting or time-invariant, static or dynamic, immediate or long-term, focused or distributed, predictable or unpredictable, ill or broadly defined. Furthermore, framework yields may be quantitative or enormous. They could be made up of a number of interconnected frames, sub-cycles, or pieces. The cycles that interact with the complex frameworks may have a wide range of characteristics. An immense scope framework in which each component performs to its full potential and the overall framework functions adequately only if each of the individual components performs as planned. In nearly every subject, demonstrating complex frameworks is essential. This is because

models promote a better understanding of the framework and |



VI RESULTS: Fig: ANF structure

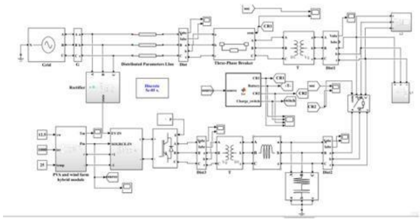


Fig: schematic diagram

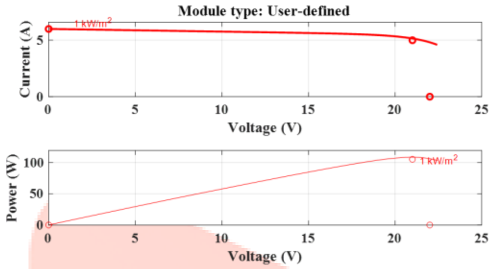


Fig: V-I and P-V characteristics of PVA module

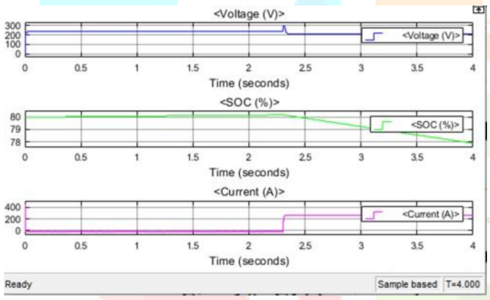


Fig: EV battery characteristic

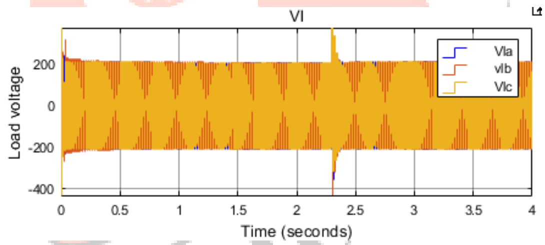


Fig: Load voltage

VII EXTENSION RESULTS:

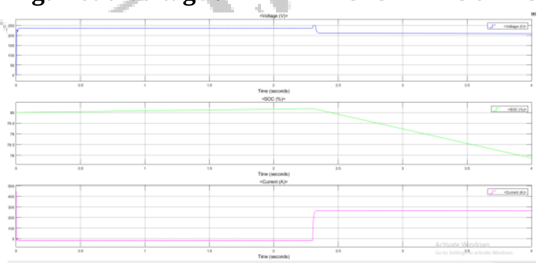


Fig: Battery graph after ANFIS

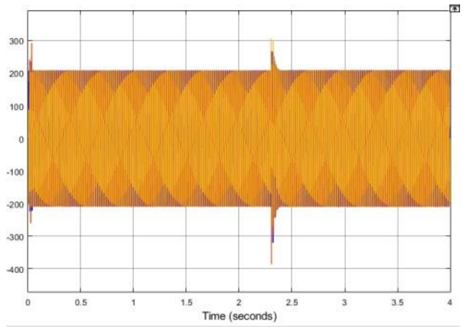


Fig: voltage after ANFIS

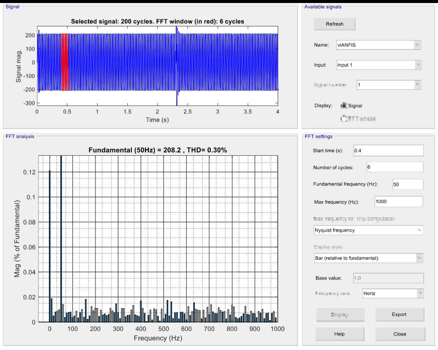


Fig: FFT analysis

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