TITLE:- Solar Based Electric Vehicle Charging Station Using Genetic Algorithm.	

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ABSTRACT

For the first time, a comprehensive model of rapid charging EV stations that are connected to a hybrid grid-RES system, such as solar, mini-hydro, and wind, has been provided. This model takes into consideration the features of EV demand as well as arrival time, departure time, state of charge, and battery capacity. This helps to maximize profits while also reducing the amount of electricity drawn from the grid. The hybrid genetic with pattern search (hGPS) method is used to run simulations for the very first time, marking a significant milestone in the development of metaheuristic techniques. They are used to tune the system characteristics of the charging station, which is referred to as the NPV. This helps to maximize the net present value. The studies are carried out with the assistance of a sequential Monte Carlo simulation and a probabilistic distribution of the EV demand determined by the behaviors of EVs and the hourly intervals. The economic considerations acquired using the hybrid genetic with pattern search (hGPS) algorithm reveal that hGPS optimizes profit when compared to the Genetic Algorithm (GA) and the Pattern Search (PS) algorithms. These comparisons were made using the hGPS method. It is also evident that the suggested method reduces the effect of the grid on the system network. This is accomplished by placing a limit on the quantity of power that may be traded between the system network and the grid..

Keywords: *EV, Genetic Algorithm (GA), hybrid grid-RES, hybrid genetic with pattern search (hGPS) algorithm, NPV, pattern search (PS), and RES.*

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1. INTRODUCTION:

The amount of energy that is required by the globe is always going up. The ever-increasing need for energy places a significant amount of stress on the traditional energy sources, which include oil, gas, and coal. However, the energy sources that are based on fossil fuels have a finite supply and also contribute to pollution in the environment. Utilising the energy that the sun provides is one way to get around the problems caused by more traditional forms of energy production. It is a source of energy that will never run out, is completely clean and renewable, and poses no threat to the environment. But before we can make widespread use of renewable energy, we must first surmount a number of critical obstacles. These include the price of energy, variations in energy, dependence on location, and the high investment needed. Alterations in the circumstances of the insulation have a significant impact on the effectiveness and output power of the PV modules [1].

A significant amount of investigation has been carried out in order to raise the overall efficiency of the PV modules. It has been suggested that there are many ways to track the maximum power point of a PV module as a solution to the issue of efficiency, and devices that use these approaches have been produced and are now available for purchase on the market [4]-[8].

Because PV modules currently have a relatively poor conversion efficiency, managing maximum power point tracking (MPPT) for the solar array is very necessary in a PV system. The operating voltage of the array is directly related to the quantity of electricity that may be generated by a photovoltaic (PV) system. The maximum power point, or MPP, of a PV system is affected by solar insulation as well as temperature [4].

GAs are promising methodologies that may be used for tackling tough technical issues and for machine learning. PID controller's optimal control parameters are calculated with the help of genetic algorithm in this research. The terms "genetic algorithm" and "genetic algorithm" refer to two different types of computer programmes that simulate the natural process of evolution [3]-[4]. It accomplishes this by gradually refining a pool of potential answers over the course of several generations. At the beginning of each generation, candidates for optimal solutions are chosen from the population based on their respective fitness values. These solutions establish a new population by means of crossover, which involves the merging of earlier solutions, and mutation, which involves altering the solutions. Because it looks for numerous peaks at the same time, it is able to avoid becoming stuck at local minima. [10]-[12].

2. LITERATUREREVIEW

This chapter provides a comprehensive review of the research on PV solar, alternative renewable energy sources, and maximum power point tracking (MPPT) methodologies and strategies. Studies have shown that solar panels can convert between 21% and 40% of the sunlight that hits them into usable electricity. To maximize solar panel performance, an appropriate Maximum PowerPoint Tracking method must be implemented.
Tong Li, Samad Yong, and Yong Li [6] In 2020, it was observed that the use of a combined system to generate power was becoming increasingly common. An appealing solution is a photovoltaic (PV) system combined with some sort of energy storage device. In this study, a grid-connected control system for a PV and battery energy system is developed.

Using a battery energy storage (BES) system and solar (PV) panels, the study develops a control system, as emphasized by Xun Ge et al. [7] in 2020. Efforts have been made to lower manufacturing costs despite the hefty initial investment for PV systems. Multiple studies have focused on developing more effective strategies for increasing the power output of solar production systems.

Researchers N. Priyadarshi et al. [8] The importance of maximum power point trackers (MPPT) for maximizing solar energy production in 2019 was emphasized. In this study, we propose using an MPPT method based on fuzzy particle swarm optimization (FPSO) to achieve this objective. In addition, an inverter control system has been gated using a modified space vector pulse width modulation (SVPWM) method for addressing ripple factor correction. Variations in solar irradiation, partial shade, and loading conditions are used to evaluate the proposed system's efficacy.

Kermadi, M. Berkouk, E. M. [9] In this year's debate, an MPPT technique with certain tweaks is offered that uses particle swarm optimization (PSO). The goal of this technique is to increase power generation with a Lithium-ion (Li-ion) battery and a photovoltaic (PV) system when PSC is present. By adjusting the length of the exploration period, the proposed strategy hopes to cut down on wasted time. To do this, a comparator is set up between the voltage produced by the PV array and the voltage used as a baseline by the PSO algorithm.

Using a three-phase, four-wire (3P4W) distribution network with PV installations, Emad M. Ahmed et al. [2019] analyzed the challenges provided by unbalanced loads, reactive power generation, and harmonics content. This research suggests that PV system grid integration is best accomplished through the use of a flexible distributed Maximum power point (MPPT) controller.

The primary factors influencing the efficiency of a photovoltaic (PV) module are discussed by K. Ding, X. Bian, H. Liu, and T.Peng [11] 2019. It is vital to have an understanding of how these influences affect the power generated by the PV array.

Awang Jusoh RozanaAlik [12] Addresses the effect of partial shade on the PV system and presents a checking methodology and an improved Perturb and Observe (P&O) approach in 2018. This verification process examined all existing peaks in the PV curve to identify the GMPP. By measuring the voltage at the maximum power point (VMPP), which is done with a P&O technique with a configurable step size, the boost converter's duty cycle may be approximated..

3. PROPOSED ALGORITHUM

Using a kind of "natural selection" in conjunction with the genetics-inspired operators of crossover, mutation, and inversion, genetic algorithmic amplification (GA) is a technique for transitioning from one population of "chromosomes" to a new population of "chromosomes." Each chromosome is made up of "genes" (also known as bits), with each gene representing an instance of a certain "allele" (such as 0 or 1). The selection operator decides which chromosomes in the population will be given the opportunity to reproduce, and research has shown that, on average, more children are produced by chromosomes that are more fit than those that are less fit. Crossover is a process that involves the exchange of subparts of two different chromosomes; mutation is a process that randomly alters the allele values of some locations on the chromosome; and inversion is a process that reverses the order of a contiguous section of the chromosome, thereby rearranging the order in which genes are arranged [3]-[4].

Bit strings are the standard representation that chromosomes assume in a population that uses GA. There are two potential alleles, or genetic variants, for each site on the chromosome: 0 and 1. One way to think about each chromosome is as a point in the search space of potential answers or solutions. The GA is responsible for the processing of chromosomal populations and the subsequent replacement of one such population with another. The GA almost always necessitates the use of a fitness function, which is a function that gives a score (fitness) to each chromosome in the current population. The degree to which a particular chromosome is successful in addressing a particular challenge determines that chromosome's fitness [10], [12].

The following is one possible implementation of the GAs algorithm:

1. Begin with a population of possible solutions to a problem consisting of n bit chromosomes that have been produced at random.
2. Determine the fitness value, denoted by the symbol x, of each individual chromosome present in the population.
3. Continue to iterate over the following stages until you have made n offspring:

a. Choose a set of parental chromosomes from the existing population, with the likelihood of selection rising as a function of the organism's level of fitness.

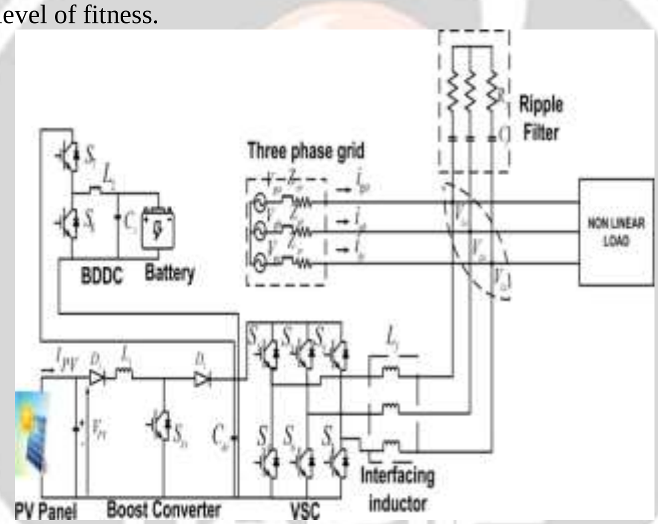

Figure 1: proposed Block Diagram

4. MATLAB/SIMULINKImplementation

MATLAB's graphical system modelling and simulation tool, known as Simulink, is powered by the Simulink plugin. On the screen, Simulink presents system representations in the form of block diagrams. Virtual input and output devices include transfer functions, summing junctions, and other devices like oscilloscopes and function generators. Other examples of virtual input and output devices are function generators and oscilloscopes. are only a handful of the numerous components of the block diagram that may be accessed. Because of their relationship, MATLAB and Simulink are both capable of swiftly exchanging data with one another. A Simulink model of a photovoltaic (PV) charging station for electric vehicles is used.

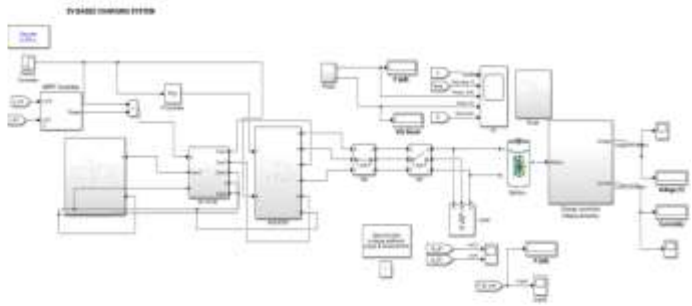

Figure 2: Matlab implementation of an electric vehicle (EV) charging station

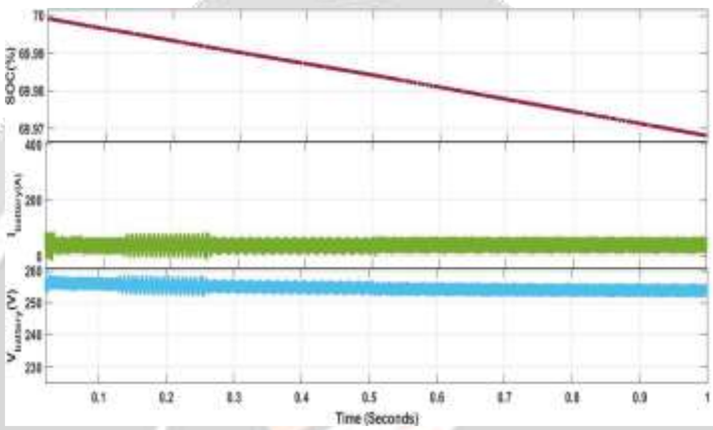

Fig.3.BoostoutputforvaryingirradiancesusingFLC(a)V_O(b)I_O(c)P_O

5. SIMULATIONRESULTS

UsingMATLAB/Simulinkthesystemperformanceanalysedunderneath numerous running situations at a line voltage of415 V, 50 Hz. The system includes a Solar PV Panel, Convertertopology, MPPT controller block which is implemented usingFLC and Battery chargingand discharging control. CV andCC strategies were used for Battery charging and dischargingoperations respectively. LMS control algorithm were imple-mentedfornonlinearloadcompensation.

The resulting waveform of Boost converter using FLC forvaryingirradianceandconstanttemperature(1000W/m^2,800W/m^2,500W/m^2and25^{0}C)areshowninfigure3.Figure9givesthePVpowerwhichgivespropertrackingduring different ambient condition using FLC. The value ofinductor and capacitors of converter used for simulation aregivenas45μHand27.7μFrespectively.Also,theinductorandcapacitorvalueforBDDCischosenas215.6μHand11.13μF respectively.

In figure 4, the PV array is charging the EV battery. Similarly,discharging characteristics of EV battery depicted in figure 5.DC load connected to the dc bus can be powered from EVbatterywithsufficientSOCwhenPVfails.

Figs. 6(a)-(d) illustrate the PV response when connectedto an nonlinear load. Figs. 6(a)-(d) depicts the grid voltage(V_g), grid current (I_g) , compensating current(I_c) and loadcurrent(I_L).

Figs. 7(a)-(e) show the characteristics under a sudden discon-nection of EV. The power needed for charging the EVs turndown because of the disconnection of EV. So, the source powerincreases and hence the power generation from the PV is notoverwhelmedbythesetransients.Also,inordertomaintainthe power, phase ‘a’ current improves as depicts in Fig. 7(c).After EV disconnection, the compensation current is same astosourcecurrentofphase‘a’.

Fig. 8 shows the THD of load current. Owing to the appear-ance of non linear load connected to the grid the THD of loadcurrent is 29.49%. Figs 9 and 10 shows the total harmonicdistortion (THD) of grid current and grid voltage using LMSwhich are 3.07% and 0.09%. Even though the load currentTHD is 29.49%, the THD of grid current and grid voltage arelieswithintheIEEEstandardforharmonics.

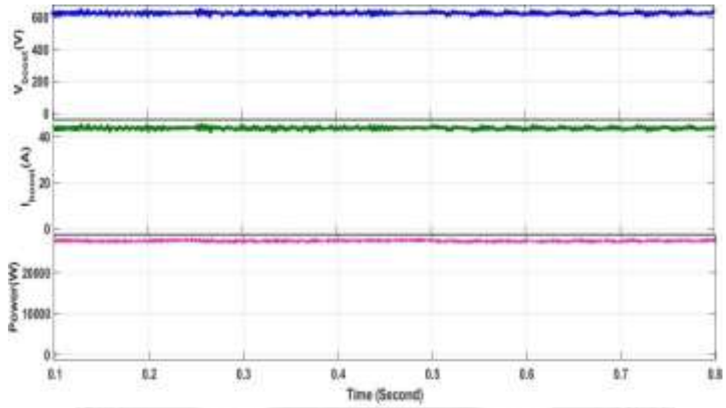

Fig.4.ChargingofEVBattery

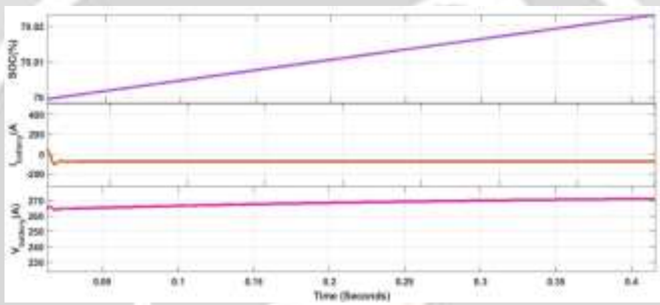

Fig.5.DischargingofEVBattery

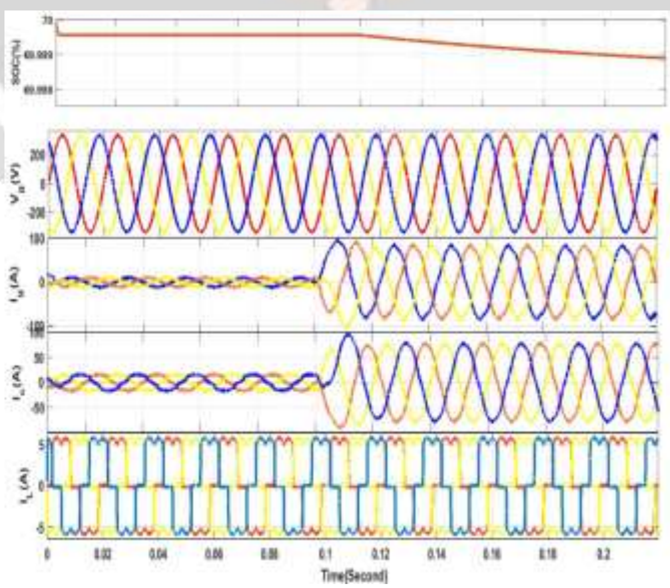

Fig.6.LoadcompensationwhenPVsupplypowertothegrid(a)Vg(b)Ig(c)I c (d)I L

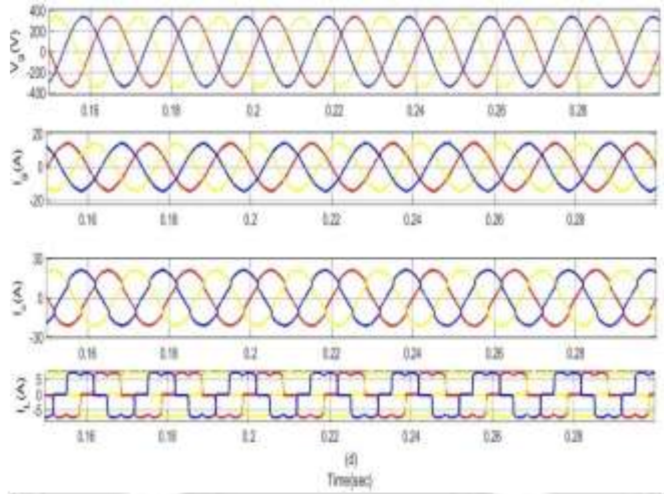

Fig.7.Loadcompensationwhenbatterystartstodischargeat0.1second(a)batterydischarge(b)V_g(c)I_g(d)I_c(e)I_L

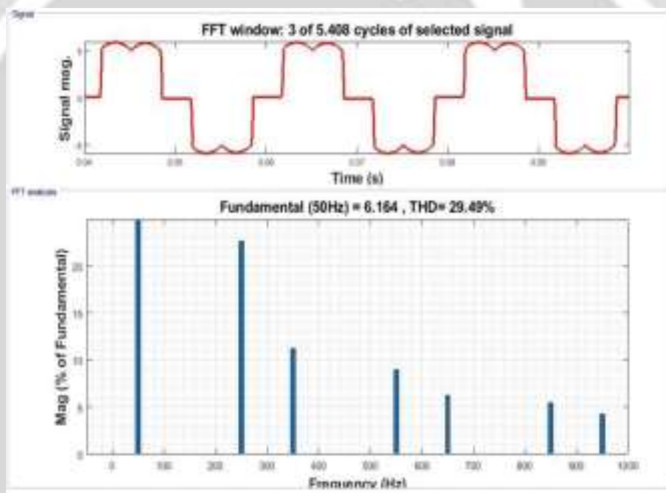

Fig.8.THDofloadcurrent

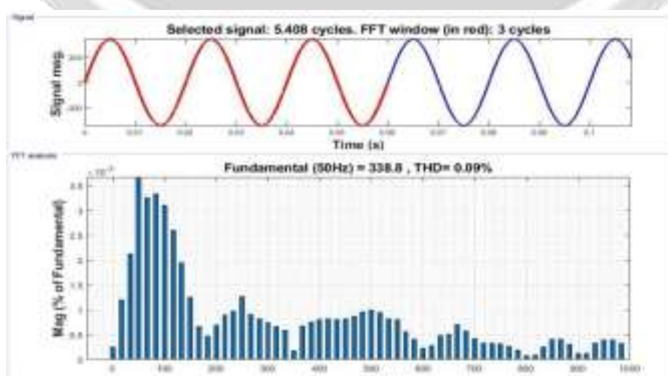

Fig.9.THDofgridcurrent

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