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Automated Scheduling And Optimization Of Load In Smart Grid Solution For Charging And Discharging Using Artificial Neural Network

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Abstract-A smart grid is defined as the combination of automation and communication that can monitor the system. It includes the two way communication network with digital communication technology. Customer participation by actively reducing or shifting the loads from peak hours to non-peak hours with respect to the pricing scheme is done by DR schemes. So the necessity of developing new approaches for Demand response in smart grid is very important considering all the aspects of the utility provider and the consumers. This dissertation aims to gain an outlook of demand side response modelling in smart grid scenario mainly focusing on residential consumers using different intelligent approaches and strategies. The two key fact of the model are maximizing the utility profit and minimizing the cost of the user considering the users comfort. DR modelling is done using genetic algorithm considering the important feature of DR congestion. New controller design with residential appliances for DR modeling is executed. The entire work proposes demand response models for residential consumers is done with a real time implementation

Keywords: Demand side response, genetic algorithm, peak to non-peak hours

I. Introduction

Smart Grid is a new revolution in electrical power systems. It represents a technical challenge beyond the upgradation of information science. In the future era, these intelligent technologies will be inbuilt in the entire power system with the target of improving the reliability, security and efficiency [1]. Building intelligence in the present day electric grid invokes the need of various drivers with the combination of different infrastructure [2].

The important aspect of the new grid system is to bring more electricity to meet the global demand. DSM forms the important beneficiary driver for smart grid systems [3]. The key goal is to allow the utility market provider to handle or manage the consumer loads. Deregulation in the electricity market has moved to the distribution of the integrated power system which combine generation, transmission and distribution. Electricity is the most expansively used energy among all forms and the demand of power is growing gradually [4]. To obtain a sustainable development in the newer technology, it

enables with the communication network with advanced technology [5]. For the prospective electrical scenario, the smart grid paves an excellent platform fulfilling the dominant electricity needs of the society like sustainability, efficiency and reliability. With the demand of electricity growing every day, increasing the capacity to meet the demand over the next 30 years is a challenging task [6].

II.Proposed system

In the growing electricity scenario, peak demand has been an important problem in both generation and transmission. Demand Side Management exhibits a solution for matching demand and supply by different programs. Particularly, Demand Response schemes target to achieve peak load reduction by adapting different consumption habits with the users. The main aspect of developing this energy efficient program among users is to avoid construction of new peak power plants. In the growing electricity scenario, peak demand has been an important problem in both generation and transmission. Demand Side Management exhibits a solution for matching demand and supply by different programs. Particularly, Demand Response schemes target to achieve peak load reduction by adapting different consumption habits with the users. The figure 1 represents the training and testing of the dataset.

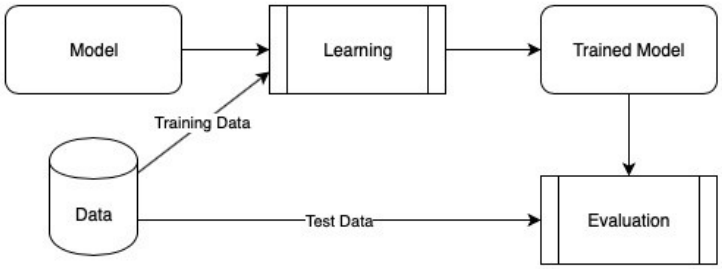

Fig 1: Training and testing of the dataset

The training and testing as shown in figure 2 of the dataset is an important stage in the machine learning model. The training data is the subset of the given original dataset. The machine learning model is trained by using the training data. The accuracy of the data is verified by using the testing data.

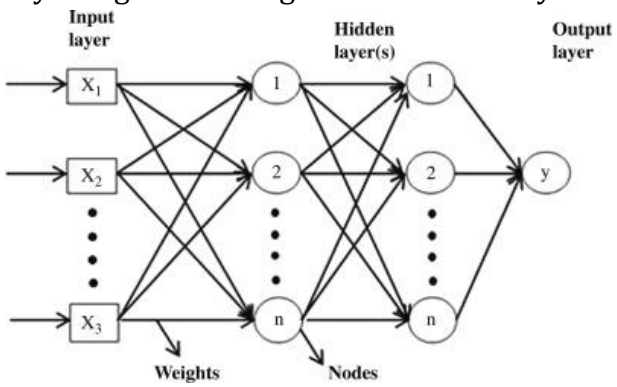

Fig 2: Artificial neural network

III.Methodology

The main objective of the system is to use the artificial neural network to schedule the loads based on the availability of the power and the demand of the consumers. The artificial neural network enables

the functioning by the computational algorithm [7]. The artificial neural network is simply called neural networks or neural nets that are inspired by the biological networks.

They are based on the several interconnections of units called as nodes. These nodes are called artificial neuron that works based on the functioning of decision making as done by human intelligence. The artificial neural networks is a computational model based on human intelligence that is composed of certain processing elements accompanied with the inputs and provide output based on the predefined functions. It is simply an extreme interpretation of the human neural system [8]. The neural network is a represented as the subset of the machine learning accompanied with the deep learning algorithms.

IV.Genetic algorithm

Genetic algorithms is based on the natural selection that functions based on the biological evolution. The constrained and the unconstrained optimization problems are solved by the genetic algorithm. The individual solutions of the population are modified by the genetic algorithm [9]. The complicated problems with larger number of variables are solved by the genetic algorithm which gives the optimum output. Creating a schedule is the first step in the functioning of the genetic algorithm. The optimum results is obtained through the comparison from one schedule to another schedule. The fitness function promotes the system for further replication of the data [10].

The electrical loads in the smart grid are optimized and scheduled based on the demand at the particular period of time. The charging and discharging of the battery at the required time helps in the maintenance of the battery's lifetime [11]. The electrical loads are programmed to operate based on the necessity and need of the consumers. They are operated based on the peak hours. The loads are controller at the smart meters that enables the genetic algorithm to control and program based on the power consumption at the peak hours [12].

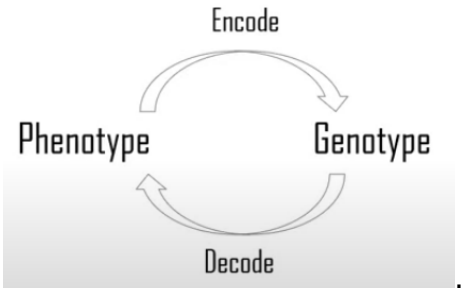

Fig 3: Stages in GA

The stages of GA are shown in figure 3. The genetic algorithm involves various stages in the analysis and identification of the desired optimum output within the given time period. The process of genetic algorithm includes the selection of the initial population with the calculation of the fitness function by selecting the desired output needed for the mutation. The mutation is defined as the random tweet in the functions to obtain a new exact solution [13]. Thus it is a generic operators that are done to maintain the diversity of the functions. The main aim of the mutation is to provide diversity and obtain the optimum solution to the given problems. It is the exploration of the search space proceeded by the selection and crossover.

This algorithm helps to have an optimized load scheduling with charge and discharging of the batteries at the particular level to obtain higher efficiency. In smart grid, the use of smart technology is essential to obtain the desired outcome [14]. Thus by using the artificial neural network, it functions based on the human intelligence by analysis and detection of the load scheduling and its need for obtaining the desired output. The power are scheduled through the machine learning through the genetic algorithm to achieve higher advancement in the network. This genetic algorithm is achieved by recording the meter reading and provides the necessary information to the user interface. This phase determines the allocation of loads needed to be scheduled [15]. The state of battery is much important in the overall functioning of the system. The battery's life time is determined through the charging and discharging operations that are done at the particular intervals of time. The overcharging can be reduced to get rid of it. The figure 4 represents the flowchart of GA.

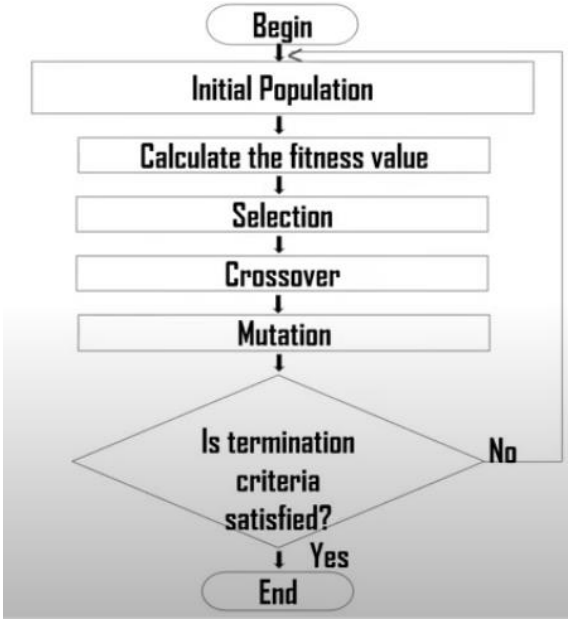

Fig 4: Flowchart of genetic algorithm

V.Simulation results

The simulation results gives the overall information regarding the function of genetic algorithm in the scheduling of power through optimization. This enables by programming the artificial neural network through genetic algorithm as shown in figure 5

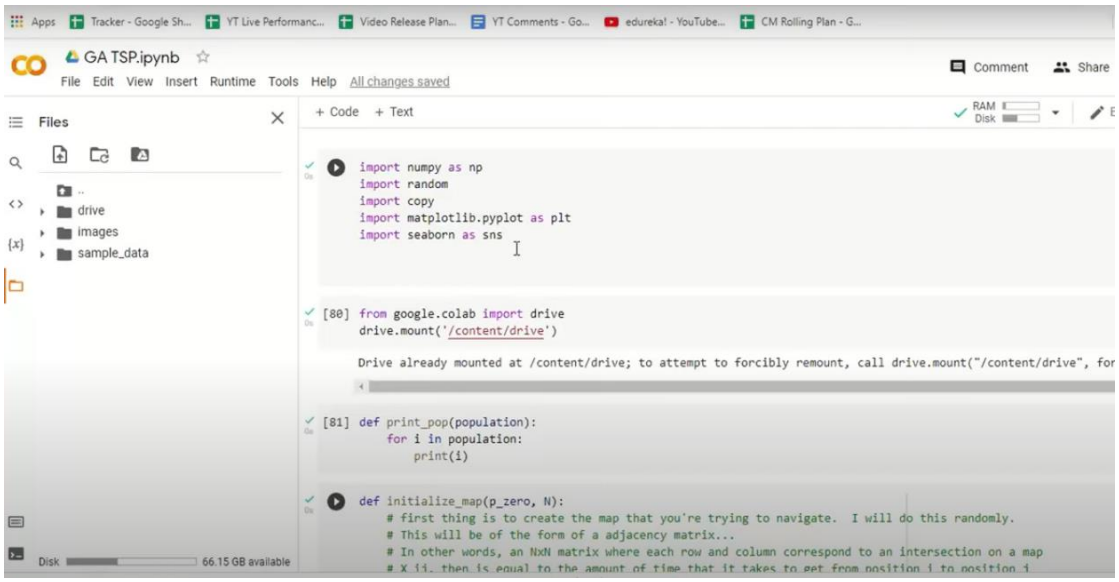

Fig 5: Implementation of GA

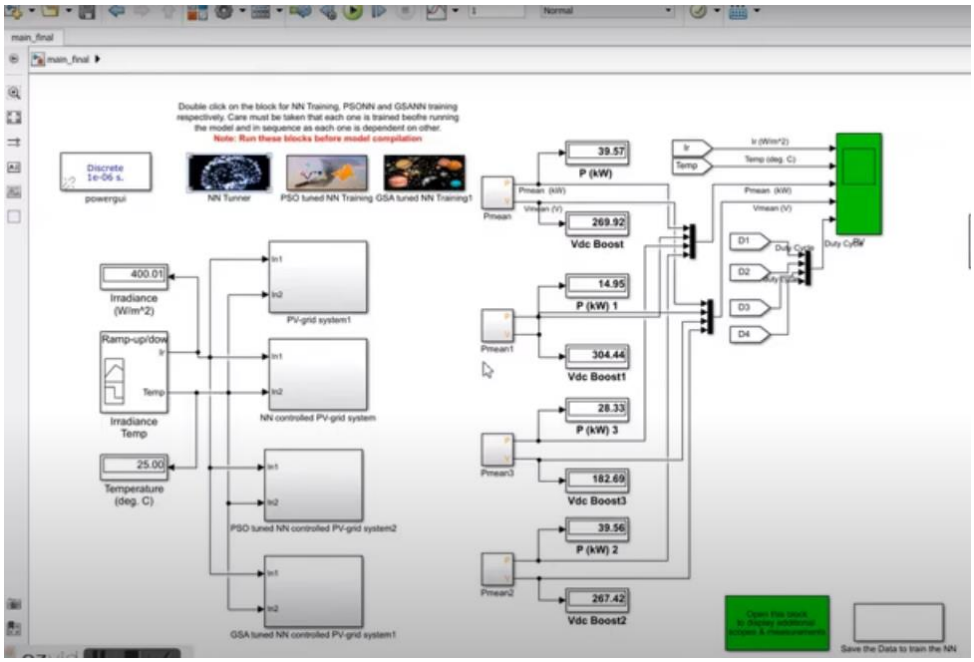

Fig 6: Simulation model

The figure 6 represents the Simulink model executed in the matlab software. The genetic algorithm allots the optimization based on the initial data input through crossover and mutation.

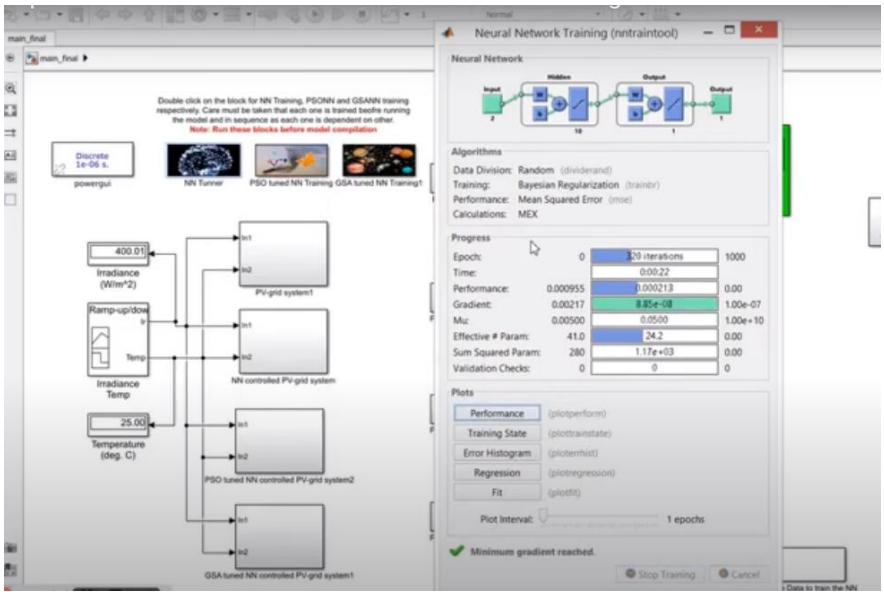

Fig 7: Neural network training

The figure 7 represents the neural network training by the number of initial layers that are processed to obtain the desired optimum solution through the hidden layers.

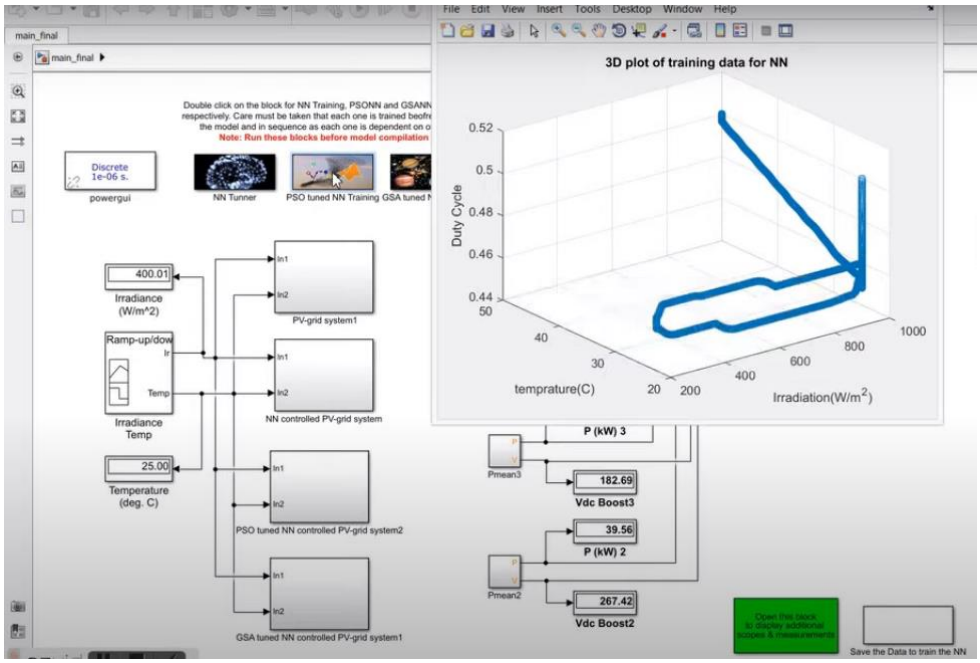

Fig 8: 3D plot data through training

The figure 8 shows the 3D plot data for the trained datasets. These obtained datasets gives the information regarding the optimization results with accurate reliable output.

VI.Conclusion

The major objective of the project is to obtain an optimized scheduling of the loads with the artificial intelligence technique to obtain higher precision. This genetic algorithm functions based on the human intelligence so that to obtain exact solution for real time problems and implementation. This system also enables the proper functioning of the system with controlling the automatic charging and discharging of the battery. Thus the system is implemented to achieve higher precision outcome with lesser computational time in scheduling and implementation.

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