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Load Forecasting Model for Charging and Scheduling of Electric Vehicle

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***Abstract*: - The project aims to develop two Forecasting models and a scheduling model. The forecasting model is built using Linear Regression method and Back Propagation Algorithm. The scheduling model is built using Back Propagation Algorithm[9].**
Load forecasting[7] can be broadly divided into three categories:
• short-term forecasts which are usually from one hour to one-week
• medium forecasts which are usually from a week to a year
• long-term forecasts which are longer than a year.
This project focuses on short-term forecasting only

Keywords: Scheduling; Forecasting; Electric Vehicles, Charging.

1. INTRODUCTION

The overall introduction about the electric vehicles (EVs)[1] along with their advantages over internal combustion engines (ICE) vehicles are presented in this introduction. Later, the characteristics of charging station (CS) demand, load forecast for charge facilities, and load forecasting models[5] for optimized charging are discussed in detail.

At the conference of Paris climate in December 2015, more than 180 countries have signed the first ever universal environmental vary agreement. In this agreement, a general activity plan is made to put mankind on track and to restrict a dangerous atmospheric deviation to well underneath 2C to cover the levels of preindustrial. This plan needs a critical reduction in emission of greenhouse gas (GHG) by starting 2020. As demonstrated by the International Energy Agency (IEA), the concentration of GHG in the climate for long period must be restricted to around 400 areas for each million of carbon dioxide equivalent. With worldwide energy crisis and increased pollution of the environment, EV has picked up opportunities for advancement lately, because it has various favorable circumstances, for example, low energy utilization, less pollution, etc. The advancement of EV depends on the establishment of infrastructures, for example, Charging Station as shown in below figure, is the most significant component of the misusing market for EV

Load Forecasting[2] for Charging Facility Based on Electric Vehicle Users' Behavior Habits

- Firstly, it emphasized the examination of clients' demand for travel.
- Secondly, decide the suitable loads as indicated by the degree of clients' acceptance to the initial SOC so the likelihood delivery of charging necessity can be resolved.
- Lastly, on the basis of the delivery of probability, the proportion of loads and vehicles can be permanent, and a load of the CS can be forecast. At present, the gauge model dependent on the clients' movement practices has been full-grown, yet the thought of affecting elements isn't favorable. Most of the study accepted that the clients simply charge their battery once in a Introduction 9 day and haven't considered for multi charging and discontinuous charging in a day. Likewise, the ongoing examines chiefly center around the interest estimate of charge control, scarcely considering the connection between the charge control and the amount of charge office.

The strategy depends on the forecast of a population of the EV and, joined with the influencing terms, determined the charging power and limit of charging facilities. At last, with a permanent proportion of piles and cars, the demand for the load can be resolved. Estimate the number of EVs in both short-term and long-term respectively with the elastic coefficient technique
The day-by-day demand of EV CSs are complicated and the algorithms of conventional load forecasting[6] (CLF), for example, regression analysis and linear time series hardly have the capacity to simulate the complex electric load of power. Instead of the CLF techniques, the modern way of load forecasting[10], machine learning techniques can self-learn and perform nonlinear modelling and adaptation.

2. MATERIALS AND METHODS

Significance of Load Forecasting for Electric Vehicles Charging Scheduling

The world especially developed countries are shifting rapidly from fossil fuels automobiles to EVs. There is expectation of increase in number of EVs all over the world. A reliable mechanism of EV charging will be necessary for its effective integration into the power system, which is necessary for stability and reliability of power system. Uncontrolled method of EVs charging causes huge deviation in electrical grid which affects the power quality of power system. As a result, high energy

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consumption, high load peaks and degradation of power quality is occurring. Scheduling and forecasting are mainly used to control and minimize the impact of these following mentioned factors.

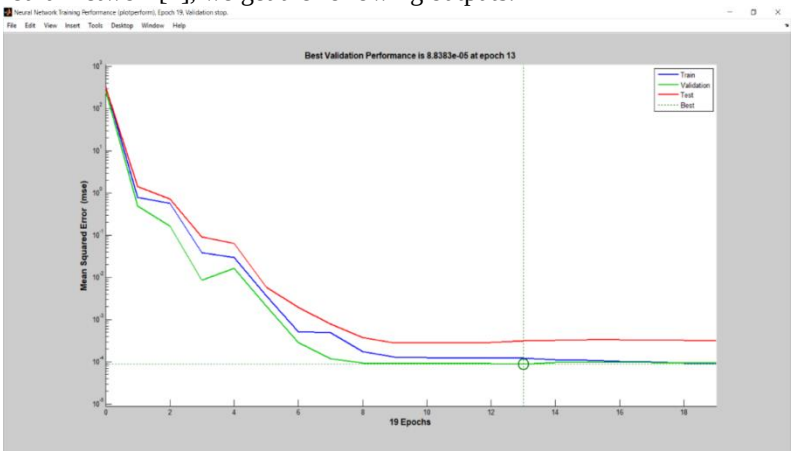
In forecasting approaches, error avoidance and network stability are crucially reliant on the forecasting of the everyday load demand. The precision of the EV charging forecast is necessary for development and management. The performance of a very precise forecasting model will support the improvement of EV charging and inspire productions to encourage the usage of EVs. The stability of the power grid and guarantee the balance between the electricity supply and demand is achieved by appropriate scheduling of EV charging.

Scheduling of the load

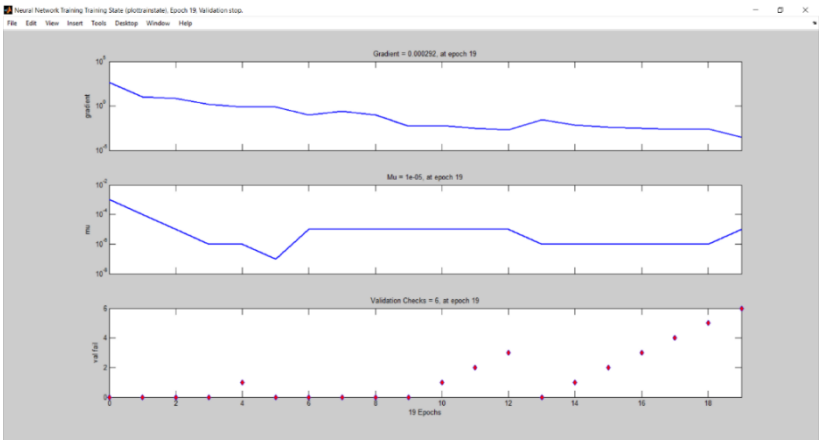
When variable pricing scheme will be employed scheduling will be a highly efficient method to manage load on the grid and cost of energy[3] .
The electricity industry is facing an increase in demand as well as a remarkable technological development. However, the supply of electricity is not increasing at the same pace as that of the demand. Demand management has thus become the need of the day. Dynamic pricing can be a good tool for demand management but due to regulated nature of the electricity market in most places, consumers face flat tariffs. This pricy policy leads to consumption of electricity by users in a way that leads to high aggregate demand at peak periods straining the capacities and low aggregate demand at off-peak periods leading to inefficiencies of generation. The problem of this demand supply mismatch can be handled by dynamic pricing and the use of automation in the scheduling of operation of the household appliances. Dynamic pricing in the form of different prices in different times of the day can influence customer behavior to consume more at low prices and less at higher prices. The time span of a day (24 hours) can be considered as a cycle for the load curve[8]. The rescheduling of the use of electrical appliances from peak to off-peak hours eventually flatten the load profile.

3. RESULTS AND DISCUSSIONS

After training the neural network[4], we get the following outputs.



Neural Network training Performance



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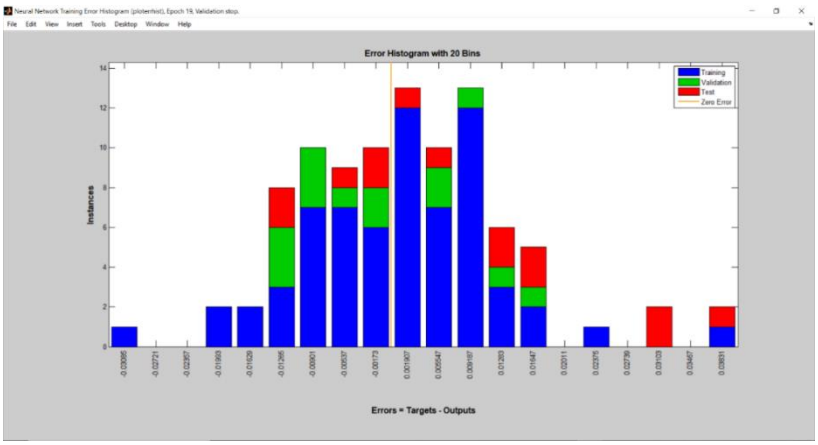
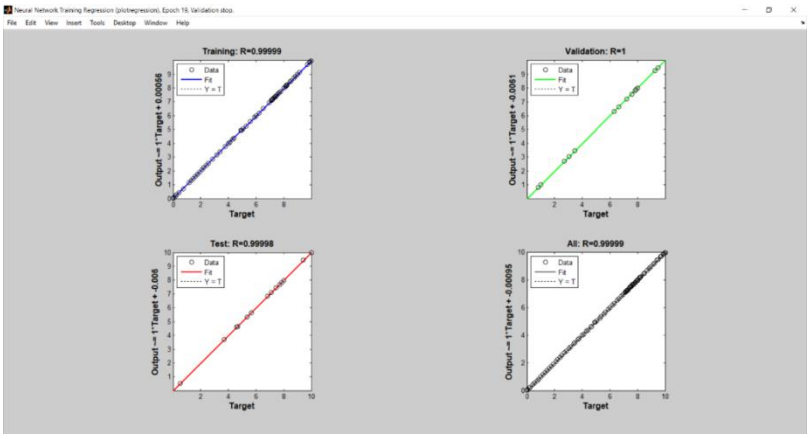
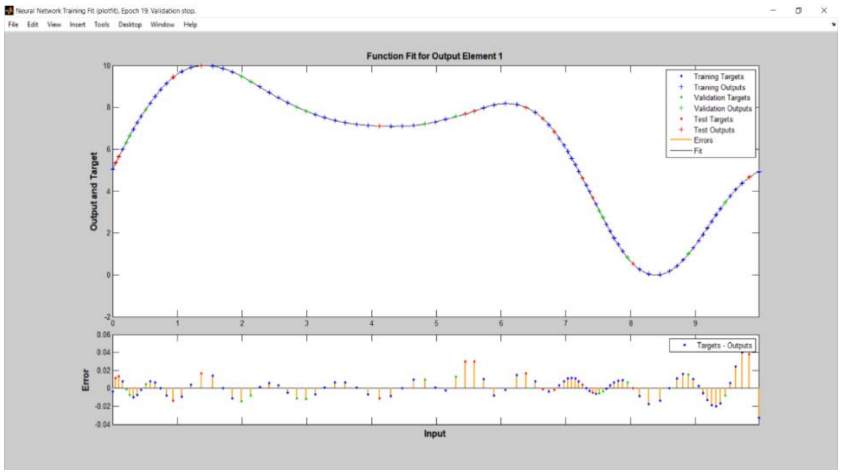
Neural Network Training State



Neural Network Training Error Histogram



Neural Network Training Regression



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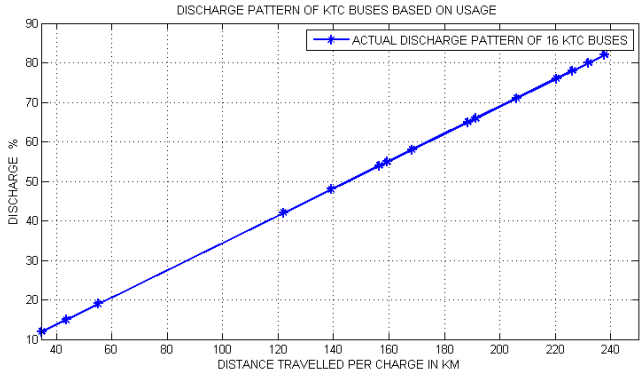
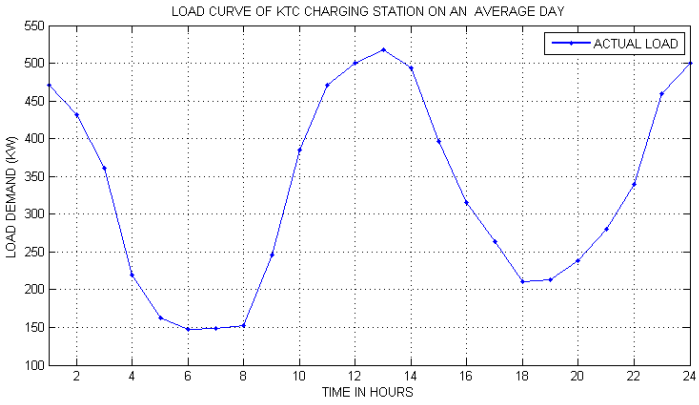
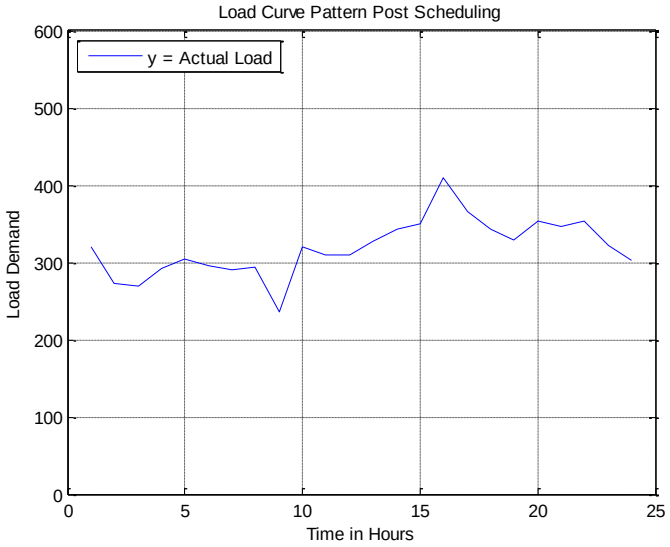
Neural Network Training Fit



Discharge Pattern of Vehicles



Normal Day Load Curve



Load Curve after Scheduling

4. CONCLUSION

In this project we forecast the load on the grid due to EV charging and schedule it accordingly implementing demand side management strategies to shift the load during peak to off peak period. We use Artificial Neural Network to for load forecasting and scheduling purposes to create a Load Forecasting Model For Charging And Scheduling Of Electric Vehicles.

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The ANN model is founded to give more accurate with less mean absolute error for short term load forecasting. On the basis of load forecasting
cost of electricity will be modeled as function of forecasted load. The optimal scheduling scheme allows scaling but will be difficult to implement when number of EVs will increase suddenly.

Future Work
In this project we forecast and schedule the excess load on the grid due to EV's charging to minimize the cost of power but various components like the type of chargers used, SOC of the vehicles before charging, random increase in number of EVs can be taken into consideration when designing a mode in future to give more efficient solution to the issues.

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