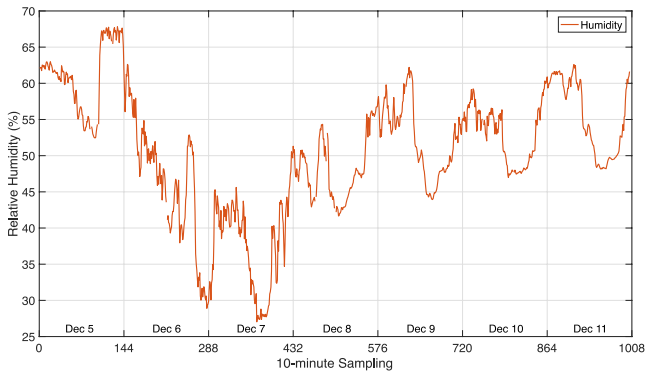

Fig. 3. Outdoor relative humidity between December 5 and 12, 2017.

In order to perform the forecast process, scaled conjugate gradient (SCG) algorithm is used with multilayer perceptron (MLP) ANN as shown in Fig. 4.

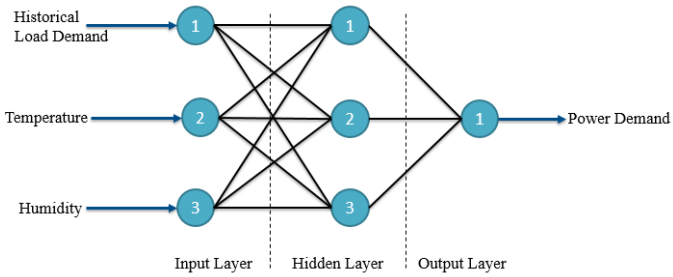

Fig. 4. MLP ANN topology.

For comparison, SVM model which performs epsilon type support vector regression (ε-SVR) with a Gaussian RBF kernel is utilized. 10-fold cross validation (CV) technique is employed for both MLP and SVM models.

IV. Discussion and Results

In order to determine an accurate ANN model that predicts 10-minute sampling air conditioning load, the number of hidden neurons is altered in every training process. The data are separated into two parts for training and testing. Thereby the trained model is validated by testing stage.

Evaluating the performances of different machine learning methods on data sets, the most commonly used performance metric for error calculation in the energy forecasting literature is MAPE which can be formulated as

$$\mathrm{MAPE}(\%) = 100 \times \frac{\sum_{t=1}^{n} |(X_t - X_t')/X_t|}{n} \qquad (1)$$

where X_t is actual or measured output, X_t' shows predicted output, and *n* indicates the number of observations [25].

From Table 2, the SCG learning algorithm based ANN model with 18 hidden neurons gives a better consequence when compared to other ANN models with different number of neurons in the hidden layer.

TABLE II. Result Table of Applied Models

Model	Neuron Number in Hidden Layer	MAPE (%)	
		Training	Testing
MLP ANN	11	8.04	8.35
	18	7.93	8.31
	25	7.92	8.33
	36	7.85	8.33
	42	7.80	8.37
SVM (ε-SVR) (RBF)	N/A	**7.78**	**8.17**

In SVM method it is important to specify cost parameter (C), regularization parameter gamma (γ), and ε parameter. These parameters directly affect the accuracy of the model and decreases the error rate. According to performance metric MAPE results, SVM model results in performing the best training and testing MAPE values. The best value of MAPE is calculated as 7.78% and 8.17% for training and testing stages sequentially.

V. Conclusions

For the continuous operation of server rooms in hospitals, supplying air conditioners without any interruption is vital. Installing PV systems to feed in the air conditioners not only make the Earth a better place, but also increases the reliability of the air conditioners while ensuring the nonstop execution of the server room.

Monitoring has come into prominence by the recent integration of smart grid, and load forecasting is an essential way to find base and peak demands of a facility. With the advancements in IoT, remote sensor mechanism has provided ubiquitous monitoring for achieving load forecasting in various horizons.

In this paper, a designed smart plug by using Arduino is utilized as a data logger for measuring, monitoring, and storing electric load demand in the server room in a hospital, and input parameters are employed for 10-minute ahead IoT based air conditioning load forecasting by applying ANN and SVM in the very short-term horizon.

As a result, MAPE performance metric results show that SVM has better performance with respect to ANN for very-short term IoT based forecasting of air conditioning loads.

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