A Framework of IoT based Smart Building Systems Using Thermal Energy

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Abstract **- Using Internet of Things technologies, intelligent controls in buildings to reduce energy consumption. Climate control in building is strong research interest due to energy savings is high potentials with heating, ventilation and air-conditioning (HVAC) controls. Because the operation of HVAC systems directly influences with thermal comfort, specific building thermal models are needed for proper control. The project is developed by using advantage of IoT technologies, the framework is used is plug & play learning framework and without manual configuration thermal model of each thermal zone in a building is automatically identify. This project shows the validity of the propound IoT based thermal model and offers a logical solution for giving reliable thermal models to future smart building climate controls.**

Based on the Internet of Things (IoT) development of models for household framework leads to the establishment of smart appliances for improving the living style more and more and support of residents. Due to this reason, energy is useful becomes an increase in demand for the past few decades that especially usages in smart homes and buildings as people of developing rapidly and based on modern technology enhancing their lifestyle. Various parameters like surrounding weather variables, building characteristics, and energy usage pattern are dependable sources of buildings energy performance. In this experimental study, a predictive model is proposed by integrating the mechanisms of IoT and classifier ensemble techniques for forecasting the indoor temperature of the smart building.

I.INTRODUCTION

With an increasing global concern for energy conservation and carbon footprint reduction, energy efficiency improvement has become the center of many research efforts. Residential and commercial buildings in particular, accounting for around 39% of the total energy consumption in the U.S. in 2017 and over 70% of the total U.S. electricity usage, have great untapped energy-saving potential. Greatfullness to the Internet of Things technologies and latest development on modern learning and control algorithms, the concept of smart homes and smart buildings has become reality. Recently, only large private enterprise buildings could afford to install building energy management systems due to their high costs. Such systems, with the most basic functionality, have an estimated initial cost on average of U.S.$2.50/square foot making them prohibitive for the majority of home/building owners. Most of solutions have now become available with the advantage of Internet of Things-based smart devices. Likewise open source Internet of Things based smart building software platforms, Home Assistant and BEMOSS. Given these Internet of Things platforms, a different smart building solutions have been developed for purposes of such as occupant number and activity detection, health care in smart homes and many energy related applications and services. these Internet of Things platforms, a variety of smart building solutions have been developed for a range of purposes like as occupant number and health care in smart homes and many energy related applications and services.

II. PROCEDURE

Storage devices play a very important role in reducing energy consumption and cost in building energy systems since they can improve the efficiency of renewable energy resource utilities and the flexibility of time-of-use Time of Use electricity prices. One of the salient features of building energy systems is that thermal energy provided by HVAC systems may take more than 40% of the total building energy consumption. Although, some efforts were made to study the building energy system integrated with both thermal and electrical storage devices. As there are

many types of storage devices, and selecting the appropriate storage devices is very important for building energy efficiency based on quantitative performance. Management of such devices with the Time of Use electricity price in a microgrid, the aim is to minimize the energy cost while satisfying the occupant demands. This problem is very challenging, and few efforts have been made to address the difficulties in evaluating the storage devices in building smart energy systems.

III. MATH

analytically, the accuracy of the model is calculated as the degree of close of a measured value to the actual value. The formula for calculating the accuracy is given equation 1.

$$Acccuracy = \frac{True\ Positive + True\ Negative}{True\ positive + False\ Negative + True\ Negative + False\ Positive} \quad (1)$$

IV. METHODOLOGY

In this research, the buildings present different areas that are installed with a monitoring-system which are used to construct of dataset having parameters and buildings multiplicity. Data sample corresponding to 1 month is collected by using monitor in the year of 2021. This study utilized prediction technique based on time series, which spaced every fifteen minutes where each data-point is standard of final quarter.

A predictive control system was easily integrated with the estimation in which a seasonal pattern trend and cyclic-variation are followed by each data point by long period like a year. The statistical learning models can be comprehended by non-linear or linear trend with the pattern that followed by data points generally. The input data and its types are used for forecasting time series in which the past values are examined for predicting the future values on the assumption by following the past one's similar trend. Samples number of past data is mostly used for forecasting models and in future, the time duration is needed for forecast.

V. RESULT AND DISCUSSIONS

The proposed classifier ensemble technique is employed for the normalized data and the metrics are evaluated and given in Table 1. There are mainly three techniques are combined which is known to be Support Vector Machine, LR, and RF models and the results are compared with existing new techniques. The proposed model can incur Over fitting when the trained dataset is taken more than the expected in which it could not differentiate the noise and signal. The efficiency of the proposed work for the new dataset can be improved by treating the random noise fluctuations as earning process for future performance. From Table 1, we can see that Neural Networks obtain about 89.13% when compared with SVM we get 79.86%, Ensemble having 87.995%, and the model is obtaining 92.256% which is more better than the latest techniques. Under fitting is the method that undertaken when the model performs poor learning technique for the data and having insufficient dataset. Searching a midway ground between the data could be suitable to form as a good model fit when the error occurs during certain amount of training or timing of the dataset. In this research, the Random Sub sampling and k-fold cross validations is used for testing the performance of the proposed model to avoid over fitting and parameters are tuned with original training-set and keeping test-set unseen. The real-time and predicted value of the proposed model is shown in Fig. (a) for detailing its efficiency.

	Temp-Indoor (°C)	Temp-Outdoor (°C)	Solar-Radiation (W/m²)	Humidity from Outdoor (g/m3)	Lighting from Indoor (g/m3)
Count	2910	2910	2910	2910	2910
Min	12.076	5.012	-4.215	26.517	12.670
Max	25.125	26.012	875.529	71.584	144.270
Mean	18.645	14.570	233.924	53.619	44.015
SD	3.125	5.236	305.452	11.045	46.412

Table 1

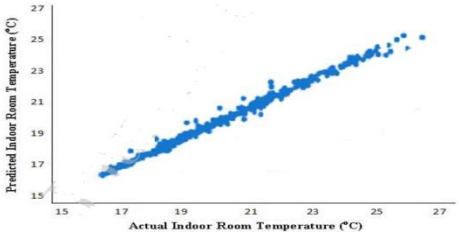

Fig. (a) The real-time and predicted value of the proposed model

VI. CONCLUSION

Conclusions are drawn based on the results obtained from experimental and characteristic analysis of proposed system.

In this study, an approach is presented by combining the IoT and Classifier Ensemble techniques for predicting the indoor room temperature of buildings. The consumption of energy for the building are reduced by predicting the indoor temp with account of cooling and heating strategy which controlled automatically for the devices that consumes high energy over any network. This model helps users to efficiently for setting the room temperature with the help of learning algorithms that make the selections as per the consumers and the temperature is positioned automatically by using the methodology.

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