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Prediction Methodology of Energy Consumption Based on Random Forest Classifier in Korean Residential Apartments

Fazli Wahid and Do-Hyeun Kim

Department of Computer Engineering
Jeju National University, South Korea.
wahid_uomian@hotmaiand kimdh@jejunu.ac.kr

Abstract. Recently, we are focusing on managing the energy system automatically. The smart grids perform much functionality like a self-healing capability, a self-resistance to external attacks, and actively engage the consumers. Also we provide high quality power to consumers in the operation environment of smart grids. In this paper, we propose a prediction methodology based on random forest classifier of energy consumption in Korean residential apartments. The prediction consists of three stages namely data retrieval, data processing and prediction. The prediction results help the energy suppliers to make decisions for the provision of energy to different apartments according to their demand.

Keywords: Energy Consumption, Residential Buildings, Random Forest

1 Introduction

In order to manage the power consumption in residential buildings, many problems are faced by the power generation, distribution and management systems. To overcome these problems, the power system needs to be fully automatic. In order to fully automate the power systems, the smart grids have been introduced. The introduction of smart grid has brought many improvements and enhancements in the power management systems by integrating different components of the power systems including sensors, actuators, controlling and other devices [1]. For bringing improvements in the power production, maintenance, planning and operation of the energy management systems, the smart grid makes use of modern technologies [2].

Energy conservation in the building is one of the challenging sectors in research In order to manage the energy system automatically, the smart grids perform many functionalities for example self-healing capability, self-resistance to external attacks, actively engage the consumers to involve in the operation of smart grids and also provide high quality power to the consumers. The US department of energy has defined the functions performed by the smart grid [3]. The smart grid also provides energy to the consumers according to their demand in an excellent manner. The energy market also plays an important role in the energy production, operation,

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distribution, and consumption system. The energy market sets prices between the energy producers, suppliers and the end user. In order to set prices in an efficient manner, the daily energy consumption prediction of different residential buildings is very important. The residential sector utilizes a high percentage of the total energy produced by the energy production system and therefore the energy suppliers give much attention to the residential sector [4]. This prediction will assist the power suppliers for making proper decisions related to the power demand by their end users and will also help in managing the smart home automation system [5].

In this paper, we present a prediction methodology of energy consumption based on random forest classifier in Korean residential apartments. This prediction methodology helps the energy management system in setting the prices of energy according to consumption of different apartments.

2. Prediction Methodology of Energy Consumption Based on Random Forest Classifier

A simple model of prediction is one in which the prediction is based on the method of classification based on some historical data. The proposed methodology divides the apartments into either low power consumption apartments or high power consumption apartment according to their daily energy consumption. This prediction can be helpful for the energy retailer in their future plan of energy demands for the residential apartments. The proposed prediction procedure of energy consumption based on random forest classifier is shown in the figure 1.

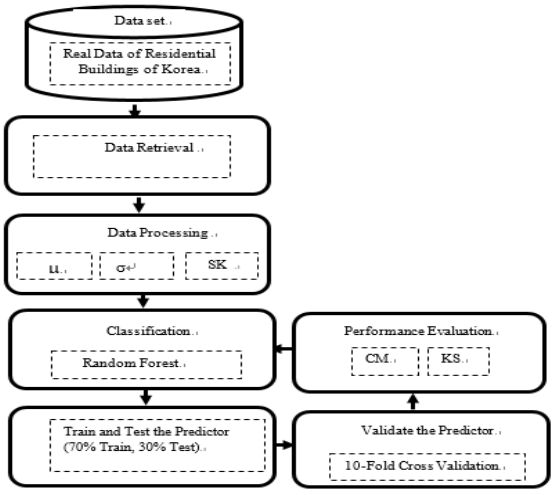

Fig. 1. Prediction procedure of energy consumption based on random forest classifier

The hourly consumed data of 520 apartments of Seoul, Republic of Korea has been used in the experiments. The data has been divided into 70% (364 Apartments) training and 30% (156 Apartments) testing. The whole process consists of three stages explained as follow

In the data retrieval stage, the hourly consumed data on daily basis for processing is retrieved from the excel database. For the prediction of apartment according to their daily energy consumption, we have historical data that contains the hourly consumed energy on daily basis.

In the data processing stage, the hourly consumed data is selected from the retrieved data; the mean, standard deviation and skewness of the daily consumed data based on hourly consumption are computed. The mean, standard deviations and skewness are computed using standard formulas.

In the apartment prediction stage, the apartments are predicted according to their power usage. Two types of apartments namely low power consumption apartments and high power consumption apartments have been predicted. For the prediction, random forest has been used. During training and testing stages of the predictor, the data is divided into 70% (364 Apartments) training and 30% (156 Apartments) testing.

The performance of the model was evaluated using classification accuracy (confusion matrix) and Kappa statistics. For the validation of the proposed model, 10-Fold cross validation was applied. For 70% training and 30% testing, the algorithm gave 94.34% accurate results whereas for 10-Fold cross validation, the algorithm gave 92.11% accurate results, which shows the effectiveness of the proposed model. The Kappa statistic observed for 70% training and 30% testing was .859 whereas .815 value of Kappa statistic was observed for 10-Fold cross validation.

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