Indoor air quality evaluation in intelligent building

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Abstract

The paper presents a qualitative assessment of indoor air quality, using an electronic nose, for an intelligent control of the Heating, Ventilating and Air-Conditioning systems. The study is performed from the perspective of giving a unitary control method to ensure high energy efficiency and air quality improving. The gas sensors are sensitive to gases polluting the indoors air but they are sensitive to indoors temperature and humidity as well.The data acquisition system overtakes the sensors specific response and outputs a characteristic pattern to the pattern recognition system.

1. Introduction

Intelligent building is a construction that provides its occupants an optimal level of comfort in terms of minimum use of energy from outside sources and a good integration of the building into the environment. The comfort in intelligent building involves providing needs of the occupants in terms of ambient temperature, air speed, air humidity in the chamber, air quality, workplace lighting, noise level etc. Currently, the first four requirements of comfort: temperature, speed, humidity and indoor air quality are provided by installation and equipment of heating, ventilation and air conditioning (HVAC).

HVAC systems, be they individual or integrated into the building assembly are large consumers of electricity power, mainly from the national power network. It is estimated that the energy consumed by equipment for Heating, Ventilation and Air Conditioning is one third (33%)of world energy consumption .However, there is a big waste of

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energy in unoccupied rooms or hyperventilating and hypothermia of certain chambers which causes a high degree of discomfort, even leading to occupational diseases. Breathing air quality in the working chambers, be either office or industrial buildings, is very important in terms of comfort at work and labour productivity. For these reasons, the realization of smart building is conditioned on a strict air quality control in its various rooms. This control is achieved by controlling HVAC using an intelligent system for air quality assessment, an "electronic nose".

For the evaluation of subjective non measurable quantities, such quality of food, beverage and cosmetic products, the degree of air pollution, the environmental comfort, generally accepted method is only the qualitative assessment of the respective quantity. The division into classes and categories, specific activity only for human mind and senses, became currently accessible for "artificial intelligence" (AI), based on fuzzy logic and artificial neural networks.

Inspired by the workings of the human olfactory system, was proposed a new approach to assess comfort of a site, namely "electronic nose"[1]. A system of qualitative assessment of comfort consists of a network of gas electronic micro sensors, acting as receiver and acquisition circuit, responsible for information management and an artificial neural network for processing and quality classification comfort.

The quality of indoor comfort must be assessed in terms of thermal comfort, humidity and air velocity and quality in room. Evaluation of environmental comfort should be in the same time for both objective and subjective, some preferring dry air, cold and clean, brightly lit environment, others rather warm and humid air with high concentrations of volatile organic compounds and long shadows, each large individual presenting variations on this theme.

2. Electronic Nose

An electronic nose is an electronic system capable, in many cases, meet olfactory functions of the human nose. In principle, an electronic nose should include a network of sensors, conditioning circuits and electronic detection and analysis program signals provided by sensors. Electronic nose can be used to measure and monitor odours in any area, suggesting that it may have various applications, for example in the food industry, perfumes, household products, the monitoring of the environment in the tobacco industry, health products pharmaceuticals. The block diagram of an intelligent system for indoor air quality assessment using an electronic nose is shown in Figure 1. It is noted that the basic structure of an electronic nose comprising: a network of electronic gas micro sensors no selective but very sensitive, a data acquisition system and a system of pattern recognition (artificial neural network).
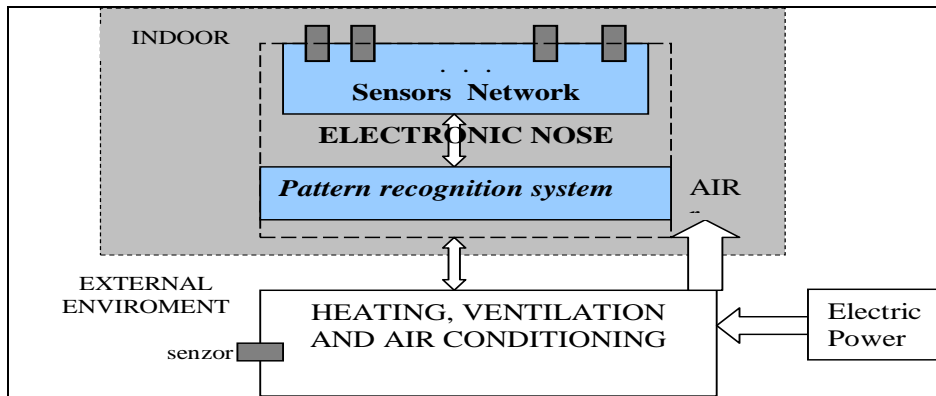

Fig. 1. Intelligent system for indoor air quality assessment.