KALMAN FILTER BASED FORMALDEHYDE ODOR CHARACTERISTICS ESTIMATION IN PATHOLOGY DEPARTMENT, HTAA

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ABSTRACT

This paper deals with Kalman Filter based estimation for formaldehyde odor characteristics for Pathology Department in HTAA. Currently, the formaldehyde can only be measured by using an e-nose alone which is still a new technique for measurement and the enose has limited performance due to specific jig dimension and environment conditions. Hence, there is a need to estimate the characteristics that able to simulate different environment conditions. The proposed design are referring to the raw data obtained from real experiment of four different sensors measurement from e-nose. The mathematical model is then constructed in a state space representation based on the raw data to approximate the nearest possible estimation. Simulation analysis described that the approach is novel which can estimate the formaldehyde odor characteristics with small error. The developed model also open the possibilities to infer the conditions of formaldehyde for different kinds of environment.

Keywords: Formaldehyde · Odor Characteristics · Kalman Filter · Estimation

INTRODUCTION

There are many people who have health problem that related with too much exposure to Formaldehyde gas. Formaldehyde is a colourless and flammable gas at room temperature and it can be easily recognized by its pungent smell are widely used in chemical industry and manufacturing industry. Formaldehyde is a highly reactive molecule that can be directly irritating to human tissues when it comes into contact, hence it is Formaldehyde dangerous to human. It is commonly found in cigarette smoke, pressed wood, plywood, fertilizer, cosmetics, some paper products, plastics, dyes and textiles. Most people spend more than 80% of their time indoors (Kerdcharoen et al. 2011) either in offices, houses, stores, restaurant, public or private transportation vehicles. This is due to most of the household are made up from Formaldehyde as shown in Figure-1. For example, household furniture will release Formaldehyde gas which affects the indoor air quality and then being breath by human.

Formaldehyde is also known to cause cancer because it may potentially be carcinogenic (Shibamoto, 1988). By breathing the air that contains the Formaldehyde gas, human are exposed to the possibility of having cancer. Due to this reason, developments of indoor air monitoring becomes an important issue of public interest. Motivated by this condition, this paper attempts to infer the Formaldehyde gas characteristics based on Kalman Filter estimation. Detection of Formaldehyde gas by a sensor has been done for past two decades and it is still continuing from time to time until today due to its side effect to human health if the human are too much being exposed to this gas. Several types of sensor are used for this purpose such as Formaldehyde gas sensor (Scott et al. 2006), conductometric biosensor (Qu et al, 2009) and electronic nose (e-nose) sensor (Vianello et al. 2007) where each of them have different sensing mechanism while detecting Formaldehyde gas and it's have their own advantages compared to one another. Each types of sensing mechanism will transform the chemical information into other forms of signal or energy before it will give an outputs.

E-nose is one of the system that able to sense any types of odor and has been used in many applications(Najib et al (2012). Metal oxide semiconductor (MOS) sensor (Shibamoto, 1988) (Chung et al. 2013) is one of the several sensors that are used to detect the presence of Formaldehyde gas at certain close area. There are many kind of sensors being use for an E-nose e.g alchohol sensor, ammonia, and carbon dioxide. The sensor selection is based on the application that the E-nose is purposely has to examine. Another important thing that should be reminded is that the sensor could perform differently if different environment are considered. Most of the works investigated the characteristics by only using a single sensor and specific condition. Therefore, there is a need of estimation technique as there are some uncertain data that could affect the odor characteristics(Zhang et al, 2014). Preceding works have shown the presence of Formaldehyde gas is detected using E-nose. Different to Zhang et al (2014) that uses the Neural Network technique for estimation, this paper concentrates on the sensory data from the E-nose as inputs to estimate the odor profile of Formaldehyde using Kalman Filter. Kalman Filter is an algorithm that uses a series of measurement observed from