Chapter 17
A Framework for an Artificial-Neural-Network-Based Electronic Nose

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ABSTRACT

Machine odor detection has developed into an important aspect of our lives with various applications of it. From detecting food spoilage to diagnosis of diseases, it has been developed and tested in various fields and industries for specific purposes. This project, artificial-neural-network-based electronic nose (ANNeNose), is a machine-learning-based e-nose system that has been developed for detection of various types of odors for a general purpose. The system can be trained on any odor using various e-nose sensor types. It uses artificial neural network as its machine learning algorithm along with an OMX-GR semiconductor gas sensor for collecting odor data. The system was trained and tested with five different types of odors collected through a standard data collection method and then purified, which in turn had a result varying from 93% to 100% accuracy.

BACKGROUND

Technology has boomed over the past few decades bringing us all kinds of comfort and accessibility. The screens that we had once that used to be black and white are now colorful and the methods of interacting with a computer using a mouse and keyboard has now been complimented by touch, and even through motion and air gestures.

These advances have had the researchers work on different ways and methods to add more ways to interact with the computer and somehow give it more 'senses'. This vision has led to development of various types of sensors through which computers can interact with users and the environment around them. Developments have been made in the fields of various types of interactions such as touch/pressure, measuring temperature and even giving computers a 'vision' through cameras and image recognition. These advances have led to various applications in many industries.

One of these 'senses' has been enabling the computer to 'smell' or detect odor. Imagine being on a video call with a friend over another continent and being able to smell what perfume they are wearing. Or having the ability to not only take pictures and keep them as memories but also the smell of different places and occasions. Or walking through a Virtual world with an ability to know what it smells like.

The efforts of researchers in this field led to creating of an odor-sensing electronic nose first introduced in 1982 (Lee, et al., 2012) which utilized a multi-sensor array of gas sensors combined to classify odors by the detection of different gases present. Since then until now over a period of over three decades, many advancements have been made in the hardware technology of electronic noses with more sensors being introduced and many being created for very specific purposes such as detection of leakage in natural gas factories, analyzing amount of carbon dioxide in an environment. Though less as compared to special purpose sensors, there has been developments in general purpose sensors consisting of a wider array of different types of sensors as well.

Given the wide range of needs of detecting 'odors' and electronic noses still being developed. Humans were utilized in food factories and many other industries to differentiate spoiled from unspoiled food and in other applications. This approach can be unreliable at times due to the limitations of the range of odors a human nose can detect. An alternate that is used are dogs, but the cost of their training is high and they have a short life span.

OBJECTIVES OF THE RESEARCH WORK

As humans, our sense of smell is very important, and we rely on it for various tasks and functions some of which are daily activities and others which can be more important. Despite the importance of this sense, our sense of smell is usually limited both in its capabilities and can be influenced by external factors such as flu, our surroundings and other factors. Our human sense of smell can also only detect a limited number of gases due to which must be facilitated by adding compounds to different gases for humans to be able to detect it (Lee, et al., 2012).

These limitations of human olfactory system make it difficult to rely on humans for the job of odor detection in Industries. Moreover, the odor detection of dangerous gases, even though possible by humans, may be fatal. An alternate approach is to train and utilize dog for odor sensing. This too has limitations as it is expensive to train dogs, and their life span is short and limited. These limitations have led to the development of electronic noses which try to mimic the human olfactory system. Electronic noses have

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