Selecting Suitable Sensor on Building an Electronic Nose

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Abstract: - E-nose technology is commonly used in some production industries such as health, food and parfume. With help of different gas sensors, odor information can be transformed into electrical signals and these signals can be recognized electronically after being processed via computers or digital signal processors. Among all sensors in market, only responsive sensors are used in e-noses relative to odor. With this study we demonstrate how to choose the 5 sensors out of 13 that is responsive to tea odor. Radar graphs show voltage relation between tea odor and related sensors.

Key-Words: Electronic nose, sensor selecting, radar plot.

1 Introduction

Although Alexander Graham Bell came up with the idea of odor measuring in 1914 [1], real studies began in 1961 and first e-nose built by Wilkens, Hartman and Buck in 1964 [2-4]. E-nose is a system that recognizes the pre-measured odors. E-nose simply includes some chemical sensors (gas sensors) and an electronic curcuit that transforms analog voltage to digital data and a software for evaluation.

Human nose is far more complicated and sensitive in some cases than even the best e-nose we have today. Beside, e-nose technology is developing thanks to invention of newer and sensitive sensors and has its own advantages such as being able to sniff carbon monoxide and natural gas [1]. Additionally human nose loses its sensitivity with long term sniffing, called fatique. Healt status of sniffer also affects the result [5]. Apart from that humans' odor recognition, it is highly related to individuals which enlightens a great advantage of e-nose, objectivity. E-nose can operate for thousands of cycles even with dangerous gases for human without a problem. In 1997 a study [6] proved that e-nose can be sensitive than human nose in some cases such as tomato sauce.

There are a lot of studies in many areas such as parfume [7], air quality and poison gas detection [8,9], health care [10-12] and food industries [13-15]. E-nose technology and studies will certainly serve humanity for many decades.

There are several types of odor sensors, but in the e-nose there are only the odor sensors which are sensitive for the smell wanted to be sensed. This study shows how to choose 5 sensors which are related to tea odor out of 13, while setting up an electronic nose for tea quality. With this sensor selection we performed an online tea quality classification during fermantation.

2 Experimental setup

We built an odor chamber which has a sensor array with 13 sensors which is shown in Fig.1. Voltage values are transffered to a computer via a DAQ card. Sensor types and gases they respond to are shown in Table 1.

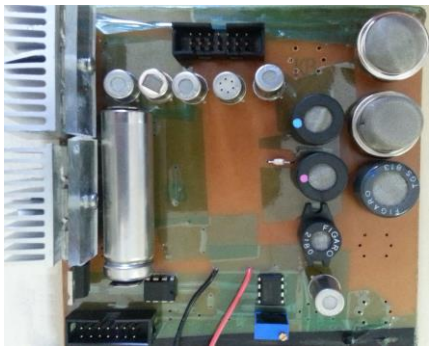

Fig. 1. 13 gas sensor array

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Table 1: Used sensors in e-nose

TGS-813 : Flameble Gases, HC
TGS-825 : Hydrogen Sulfide
TGS-826 : Ammoniac
TGS-830 : Halocarbon Gases (CFC, HCFC)
TGS-880 : Ethanol
TGS-2104 : Air Quality/ Exhaust Gases
TGS-2180 : Microwave Oven/Water Vapour
TGS-2201 : Air Quality/Double Sensor Element
TGS-2602 : Air Quality
TGS-2610 : Propane, Butane, LPG
TGS-2611 : Methane, Natural Gas
TGS-2620 : Alcohol, Organic Odors
TGS-5042 : Carbon Monoxide (CO)

With help of Fig. 2 one can follow single sniffing cycle for capturing and processing the odor. For 10 seconds valve 2 and 3 open and clean the chamber with oxigen to gain referance odor. For following 30 seconds valve 1 and 3 open for sniffing desired tea odor. Third step is locking the odor in chamber for 10 seconds and final step is same with first step to clean sensors. Totally 14 output values from 13 sensors have been recorded (TGS-2201 has two outputs.

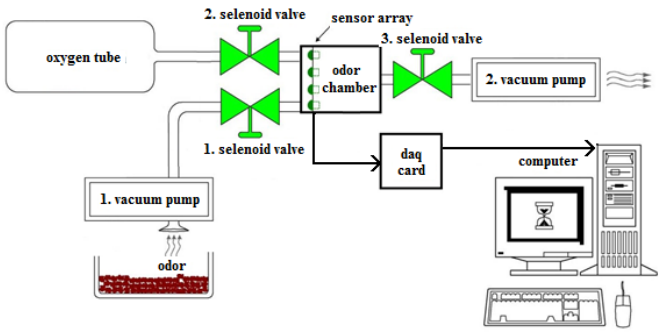

Fig. 2. E-nose setup

3 Experimental results

Fig. 3 represents voltage values of sensors for single sniffing cycle. It is seen that which sensors give more response.

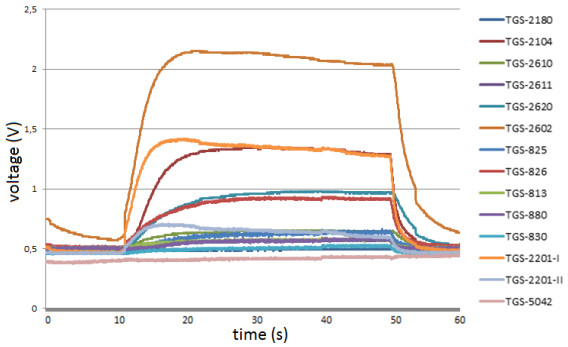

Fig.3. Sensor voltage values for single sniffing cycle

Here it has been observed that TGS-2602, TGS-2104, TGS-2620, TGS-2201-I, TGS-2201-II and TGS-826 gas sensors show distinctive conductivity change while some of the others show very little and some of them none.

Radar graph in Fig. 4 representes different quality tea's odor at different times during the fermantation. As seen in Fig. 4 TGS-2104, TGS-2602, TGS-2201-I, TGS-2201-II, TGS-2610, TGS-2620 and TGS-826 sensors give response differently to different kinds of tea.

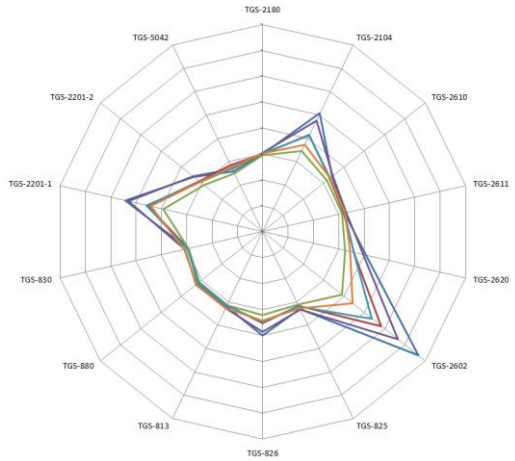

Fig. 4. Radar graph of sensor values for different type of tea odor

Fig. 5 represents sensors voltage values' variance for single sniffing cycle. Here TGS-2104, TGS-2602, TGS-2201-I, TGS-2620 and TGS-826 give a meaningful response.

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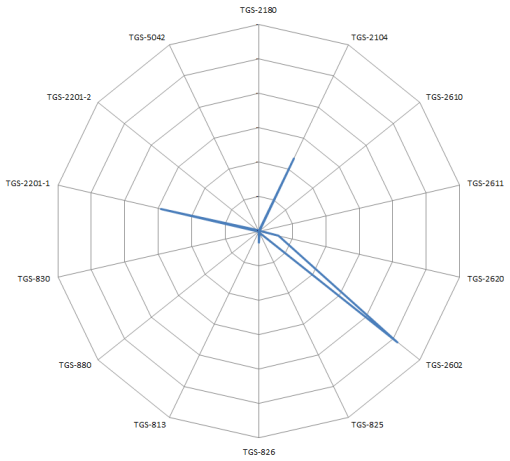

Fig. 5. Sensors voltage values' variance for single sniffing cycle

4 Conclusion

This study adresses how to choose the right sensors for the desired odor when building an e-nose. The study was conducted on tea odor, but can be applied on other odors. Odor-sensitive gas sensors can easily be detected when the substance of which odor would be determined in different situations with help of radar graphs and computer records.

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