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Recognition of Aromas from Tea Sources based on MQ3, MQ5, MQ7 Sensor Signal

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ABSTRACT

This study investigated the capacity of a deep neural network to distinguish tea types based on their aromas. The data set of aromas from tea leaves, which contained sensor responses measured with a gas–sensing system using a mass–sensitive chemical sensors namely MQ3, MQ5, MQ7, was used to evaluate the recognition accuracy. To define the input vectors of the deep neural network in aroma recognition experiments, frequency analysis using a continuous wavelet transform, with the Morlet function as the mother wavelet, was used to extract features from the sensor signals of the data set. The deep neural network achieved a recognition accuracy of 100% for the three tea types: oolong, jasmine and pu'erh, and the base gas of dehumidified indoor air. Comparing the recognition accuracy of the deep neural network to that obtained from other pattern recognition methods, such as naive Bayes and random forests, the experimental results demonstrated the effectiveness of applying a deep neural network to this task.

Keywords : MQ3, MQ5, MQ7, Morlet Function, Recognition Accuracy

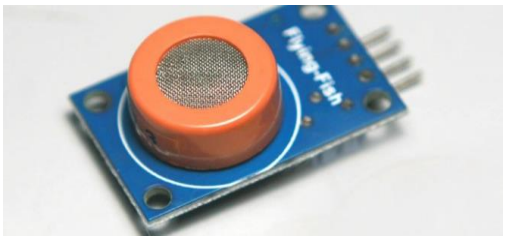
I. INTRODUCTION

This system is a smart instrument developed for detecting, analyzing, discriminating and recognizing complex odour by imitating the principal mechanisms and functions of biological olfactory systems. Its applications dealing with real–world problems related to odour are anticipated in various disciplines, such as environmental monitoring, food and beverage evaluation, flavour and fragrance testing, medical diagnoses, sending user messages, drug detection and robotics. To support this demand and develop a high–performance electronic device system, many studies on sensor devices, system integration of sensors and signal processing algorithms have been conducted.

This systems, a popular methodology uses a sensor device that transducers the response related to the concentration change of the sample gas molecules that constitute odour into an electrical signal, signal

processing that extracts the statistical or temporal features from the sensor signal, and an appropriate pattern recognition technique, such as cluster analysis, multilayer perceptions, neural networks, support vector machines and ensemble learning, that classify the sensor response using the extracted features and identify the type of sample gas. Neural networks that use deep learning Techniques have recently been attracting increasing attention in several fields and have been successfully used to solve intractable problems in image and speech recognition. The application of neural networks trained with deep learning techniques to an electronic device system may therefore be allow for recognition tasks to improve the recognition performance.

Tea is one of the most popular beverages around the world and can be roughly classified into two types based on the manufacturing process: fermented and unfermented. Each tea item has its own unique aroma; for instance, fermented tea reflects a mix of chemicals produced by the enzymatic oxidation of tea polyphones during fermentation. The use of aromas to categorize tea, discriminate its grade and evaluate its quality has become an emerging application of electronic device systems from the viewpoint of scientific interests and industrial demands; therefore, many studies have focused on recognizing the aromas of teas, such as black tea, Japanese green tea and Chinese tea. In currently we are using three sensors namelyMQ3, MQ5andMQ7 showed in Fig-1 (a), (b), (c) and applied it to the identification of tea types based on their aroma. Furthermore, the deep neural networks demonstrated a high recognition rate against the tea–type classification where the base gas was considered as a recognition class because determining whether the sample gas exists is also an important basic function of the gas–sensing system. In this study, we conducted the recognition of aromas from tea leaves using a deep neural network and compared the recognition performance with that obtained by other pattern recognition methods, such as naive Bayes and random forests, to clarify the effectiveness of using the deep neural network for this application.



(a)

(b)

(c)

Fig-1 : (a),(b),(c)

II. DATA SET OF AROMAS FROM TEA LEAVES

To conduct experiments of aroma recognition, the sensor response data set of the aromas from tea sources, which was constructed by acquiring sensor responses with a gas–sensing system, was used. As shown in Fig 2,the gas–sensing system is switched on, then next step is1) detecting the aromas using sensors that is sensor is convert the physical signal into its equivalent electrical signal, 2)then the detecting aroma signals are converted it into the digital signal, 3)the chip on the board plugs straight into your computer as a virtual serial port through this port data has been transfer to the computer,4)this system also include the GSM module for transferring the message to the customer, that is. type of tea, it is healthy or unhealthy etc. The materials of the sensorMQ3 are

detecting the alcohol, Benzene content.MQ5 Sensor detecting the High Sensitivity to LPG and Natural Gas, Flat Response, Stable and Long Life, Both Digital and Analog Outputs On-board LED Indicator. Applications are Domestic gas leakage detector, Industrial Combustible gas detector, Portable gas detector, Gas leak alarm, Gas detector. MQ7 Sensor detecting the high sensatory to carbon monoxide.

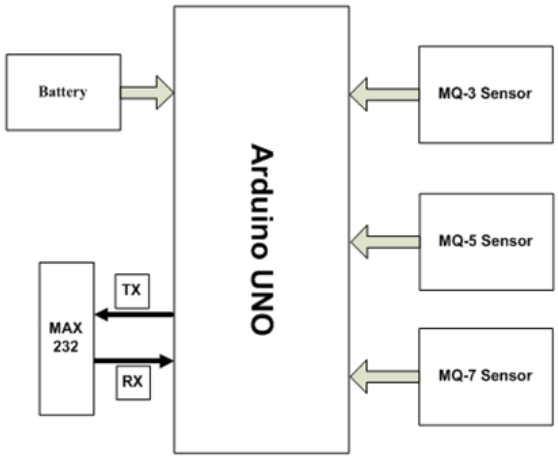


Fig-2 : Block diagram of gas–sensing system.

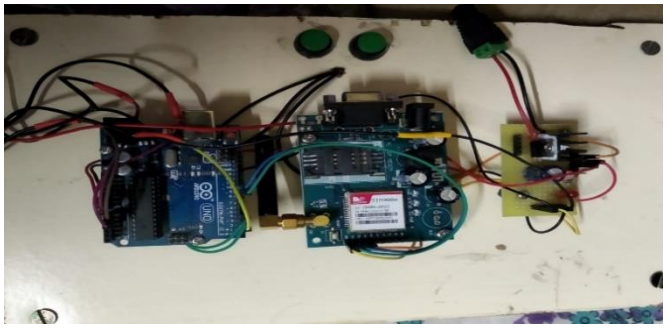


Fig-3 : Electronic device gas sensing system.

To collect the sensor responses, different types of tea sources were used as the sample gas source. The Fig-3 shows the Electronic device gas sensing system, it has combined the three different sensors in one board and detect the different gas features according to the variation of the data result will be decided.

a) Arduino module: Arduino is an open-source platform for embedded and used for building embedded electronic projects. Both the physical and programmable pin to burn the IC is present in Arduino and run the program using IDE (Integrated Development Environment) that runs on computer, used to write and upload computer code to the physical board. As a platform Arduino becomes much popular with people just who are new to Embedded, and for good reason. The Arduino does not need separate part of hardware.

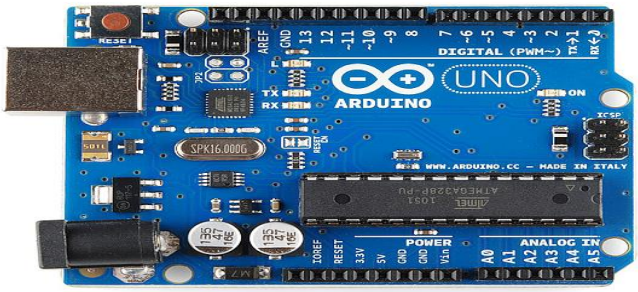


Fig-4 : ARDUINO UNO

b) MQ3 gas Sensor:

1) Features of MQ-3 Alcohol Sensor

- ✓ Sensor Type - Semiconductor
- ✓ Easy SIP header interface
- ✓ Compatible with most of the microcontrollers
- ✓ Low-power standby mode
- ✓ Requires heater voltage
- ✓ Good sensitivity to alcohol gas
- ✓ Fast response and High sensitivity
- ✓ Long life and low cost
- ✓ Requires simple Drive circuit
- ✓ Dimensions: 32 x 22 x 16 mm

c) MQ5 Sensor:

Gas Sensor (MQ5) module is useful for gas leakage detection (in home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol. Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. The sensitivity of the sensor can be adjusted by using the potentiometer.

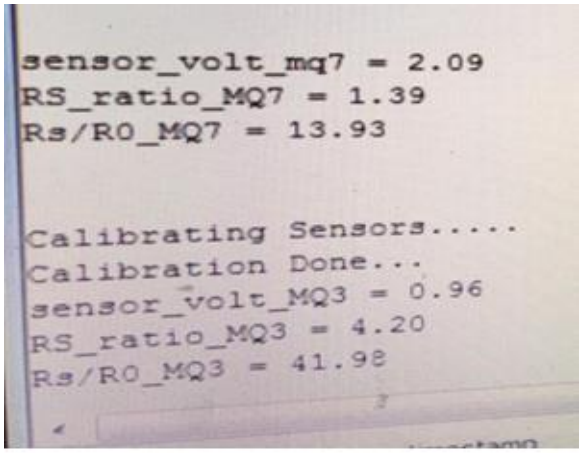
2) d) MQ-7 Sensor:

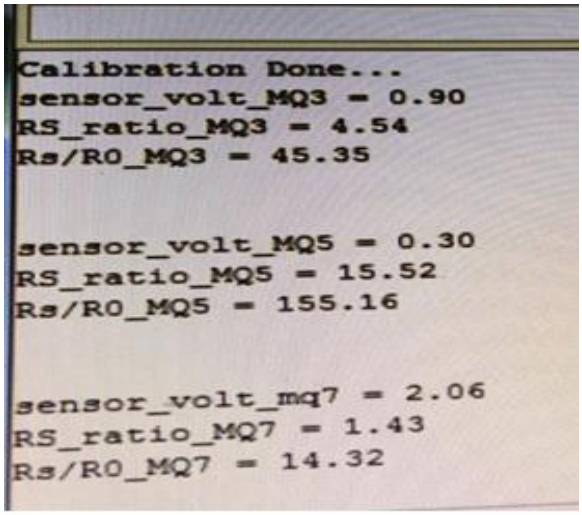
MQ-7 Semiconductor Sensor for Combustible Gas Sensitive material of MQ-7 gas sensor is SnO2, which with lower conductivity in clean air. It make detection by method of cycle high and low temperature, and detect CO when low temperature (heated by 1.5V). The sensors conductivity is higher along with the gas concentration rising. When high temperature (heated by 5.0V), it cleans the other gases adsorbed under low temperature. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration.MQ-7 gas sensor has high sensitivity to Carbon Monoxide. The sensor could be used to detect different gases contains CO, it is with low cost and suitable for different application.

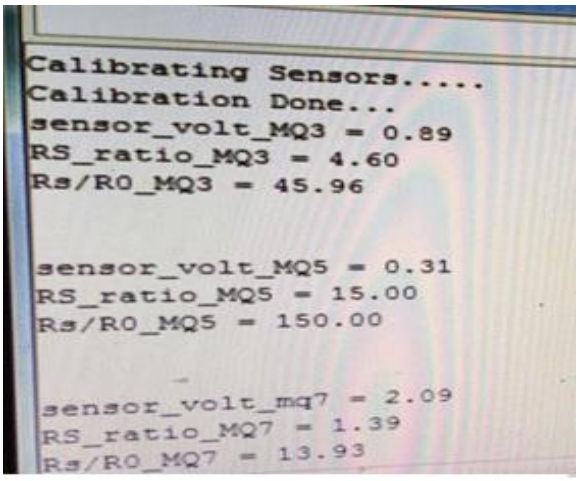
III. RESULTS AND EXPERIMENTS

An Electronic device gas sensing system, the time domain features extracted from time–series data of sensor responses, such as features are affected by variations in the temperature and humidity of the gas. To guarantee robustness against dynamic changes in the concentration of the sample gas and its humidity, the frequency domain features extracted from sensor signals using a short–time Fourier transform has been proposed. Consequently, in this study, the feature vector v used for aroma recognition consisted of the frequency domain features obtained from the continuous wavelet transform using the Morlet function as follows: v = pT 1 pT 2 pT 3 pT 4 pT 5 pT 6 pT 7 pT 8, where the component of pi ∈ RN (i =1, 2,⋯,8) is given by the mean of the power obtained in the frequency domain in the measurement period of the sample from each sensor.

Electronic device gas sensing system is first calibrating the sensors, once the calibration is done next step sensing the aromas and detecting the features of the aromas then send to the outside of the users. If the values are varied minutely the tea leaf was good and healthy and detecting data is varies more than previous value the tea source is not good or unhealthy for drinking. The data set values are simultaneously giving the same values that tea leaf was good for users. In this system we also generate the user message for customers. Sample output and values are showed in below screenshot images.







IV.CONCLUSION

In this study, we evaluated the capacity of a deep neural network for recognizing aromas from tea leaves, where the data set of aromas was obtained by using a gas–sensing system. The input vector of the deep neural network consisted of frequency domain features that were extracted from the sensor signals using a continuous wavelet transform. Experiments of aroma recognition were conducted and a recognition rate of 100% for all the tea leaf types and the base gas was achieved. Comparing the recognition accuracy
Of the deep neural network to that obtained from other pattern recognition methods, such as naive Bayse and random forests, the effectiveness of the proposed method for this task was confirmed.

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