Analysis And Detection of Lung and Respiratory Disorders

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Abstract: Recently, the medical field has emerged to be a most promising application area for electronic nose (E-nose). All sorts of upheaval/revolutions/innovations are feasible with inventiveness. The sense of sight is the motivation for the image processing, the electronic nose also called as medical nose, this technique is motivated by smell. Electronic nose are the devices which are developed to determine and differentiate between volatile organic compounds derived from exhaled breath samples from a patient. The use of electronics, replacing humans in dangerous environment has gained much attention and research on that topic is being carried out in recent times, the electronic replacement not only reduces the risk of human life but also has more efficiency. This paper discusses about one such replacement "The Electronic Nose" this can be used in chemical testing without the human intervention. In this paper, we review a work carried out to determine illness using e-nose. Precisely, applied an electronic nose to spotting/recognition of lung and respiratory disorders using exhaled breath samples. Mainly the concentration of carbon monoxide (CO) and Ethanol are determined to predict lung diseases and also analysing the obtained result by implementing Artificial intelligence.

Keywords: Electronics; Sensors; Electronic nose (ES); Artificial intelligence

I. INTRODUCTION

With the increase in the technology with respect to medical diagnosis there is much research going on for efficient yet easy detection of diseases. As part of those research for the non-invasive approach of disease prediction and observation. E-nose is a device that is comparable to the human nose, it detects the smell. The E-nose has many applications in Food and beverages, medical field, agricultural field and forestry. The E-nose is used in many applications like food industries, medical, agricultural and forestry. Here E-nose is developing for automated identification of volatile organic compounds for medical application. The VOCs are chemicals which present in the exhaled breath of a person. Most of the Volatile organic compounds are not toxic. But VOC's have long term chronic health effects. E-nose basically consists of different sensors that is used to detect the smell. The electronic nose is a smart device that uses two gas sensors which are overlapping selectively, in order to detect the odor. Here the detecting process is similar to human olfaction. This electronic nose is used for recognition, collation, quantification and other applications like output data storage and recovery.

As shown in the Fig.1 we can see the comparison between the human breath system and the electronic nose. Alike receptors in the human nose the sensors are present in the e-nose. The Electronic nose(E-nose) works on the principle of human brain to detect the smell. Basically, a smell is nothing but a vapor or gas of molecules, each molecule or each vapor or each odor will b containing different molecules of different sizes based on the size and shape of the odor molecule of the component will be decided. Whenever the human nose sense the smell it consists of receptor, different receptor for different odors, whenever the receptor senses the smell it will convert the smell in to the signal in the olfactory system that is present in the human nose and it will send the signal to the brain, there the human brain prosses and detects the smell, how the receptors are in the human nose the sensors are in the Electronic nose there will be a wide range of array of sensors that will detect accordingly to the different chemicals and instead of human brain E-nose consisting of computing system [1].
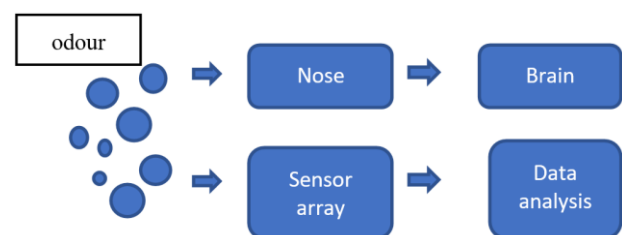

Fig 1.   Comparison between the breathing system and electronic-nose

The electronic-nose is made up of both software and hardware. Hardware can be considered as "Olfactory Receptors" while the software can be considered as "Brain" of the electronic nose.

II. METHODOLOGY

The electronic nose strives to mimic the human nose by using the sensors. These sensors will pretend to be human olfactory responses to aroma [3]. The exhaled breath samples are pinched through the sensors and the particular sensor will undergo some changes and sends the signal to the main processing unit.
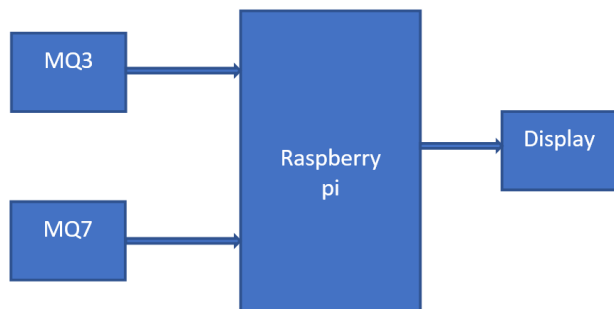

Fig 2.   Block diagram

Fig.2 shows the design flow of detecting system where the sensors get the input that is exhaled breath of a person which will be processed in the Raspberry pi the compared with the threshold value and displayed in the displaying system.

III. HARDWARE REQUIREMENTS

This specified system uses raspberry pi, sensors and a mask.

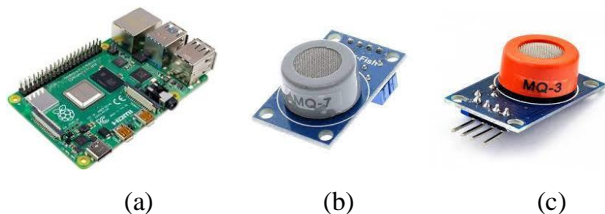(a)   (b)   (c)

Fig 3.   Hardware Requirements, (a) Raspberry pi,
(b) MQ7, (c) MQ3

Fig. 3(a) Raspberry pi is a low-cost device. It looks like a credit card. The raspberry are microprocessors. The raspberry pi consists various versions with different features [2]. It operates in open-source ecosystem. Fig 3(b) The MQ7 sensor is simple to use, it detects the CO [4]. Fig. 3(c) The MQ3 sensor is easy to use detects the Ethanol [4].

IV. SOFTWARE REQUIREMENTS

The proposed system uses the Raspberry to run the python code and Tabby Terminal.

V. WORKING

In traditional method of diagnosing lung diseases there are more chances of man mad mistakes and the process is slow and mainly they are expensive. So, the electronic nose will rectify these problems by offering solution to diagnose the diseases. This electronic nose system works on the principle of human nose. Usually, the odour made up of molecules which have a specific size and shape. The molecules which are present in the human nose have similar shaped and sized receptors. A signal will be sent to the brain when a receptor accepts a molecule and there by the brain will recognize the smell corresponding to that molecule. The electronic nose works similar to the human nose. The sensors act as receptors in e-nose. The signal is sent to a program i.e., microcontroller as an alternate to the brain. This happens when a specific sensor receives the molecule. It consists of an operative system, processing system, a sample delivery system [as shown in fig 1].

Initially the exhaled breath is sensed by the sensors, then the perception process occurs as a result the current, resistance, frequency, voltage parameter variation takes place based on the molecule sensed by the sensor. The sensors will react to a particular molecule. Then the obtained signal must be preprocessed in the raspberry pi to understand those physical changes. Then the processes data is digitalized and displayed in the display system. The output is then analyzed by implementing Artificial intelligence.

VI. IMPLEMENTATION

To build a prototype, Raspberry pi 4 is used to interface the MQ3 and MQ7 sensors. The MQ3 and MQ7 sensors will detect the Ethanol and Carbon monoxide in the exhaled breath of a person. When the exhaled breath sample is provided as the input to the sensors the particular sensor will get activated for intended chemical. Then the sensor will send the signal to the processing unit and the unit will process and give the output.

Fig 4.   Interfacing the sensor

The microcontroller i.e., Raspberry pi is preprogrammed with threshold or standard normal values. The sensors output will be processed and compared with the threshold or standard normal values if the values are in normal range then it concludes that the person is healthy, if the value is above the threshold value then it

concludes that the person is unhealthy. The obtained result will be integrated and analyzed using Artificial intelligence.

VII. RESULTS

With the development in the technology the traditional method of diagnosing is fading day by day. This paper expects to bring out a device that would detect the respiratory disease.
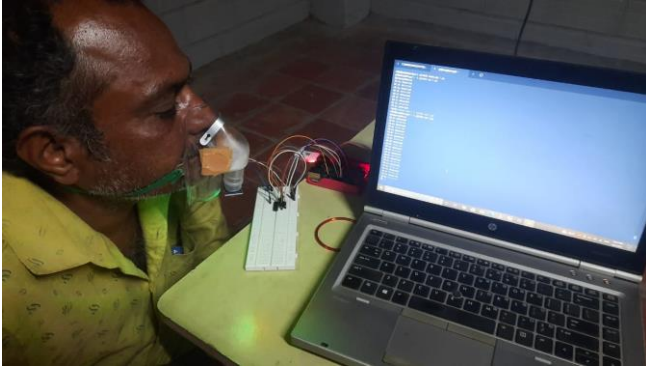

Fig 5.   Gas detection in exhaled breath

VIII. CONCLUSION

Now a days the growth in the medical field has rapidly increasing so the affinity towards personal check up and self-health diagnosis is being grown. The lungs are the one of the sensitive parts of the body which need to be diagnosed sensitively.   As compared to the traditional invasive method of detecting lung and respiratory disorders the non-invasive method of detection is quite challenging. Using a raspberry pi and sensors the volatile organic compound are determined. Human exhaled breath contains a mixture of over 3000 VOCs. In that the concentrations of Carbon monoxide (CO) and Ethanol are determined using MQ7 and MQ3 sensors. The Electronic nose consisting of two parts, the sensor part and software part. The first part can sense the chemicals and the second part is responsible for analyzing software module. The advantage of electronic nose it is fast and low-cost.

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