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Survey of Artificial Electronic Nose to Detect the Diseases of Human

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Abstract*— The main purpose of this paper is to identify the diseases of people and give the health status of people in less time and in low cost. On using artificial electronic nose. Artificial electronic nose is an electronic device which is based on chemical gas sensor and identify the volatile organic compounds present in human breath. Different type of diseases leave the different markers in breath such as nitric oxide for asthma detection, diabetes have acetone lung cancer patients have dimethylamine and trimethylamine, in the same way aliphatic acid, ammonia, sulphides etc are also markers of diseases present in human. Analyzing the presence of particular diseases is done by discriminating signal obtained through electronic nose which is based on sensors array. Transmission of odor patterns to artificial electronic nose can be done quickly by gathering the exhaled particles from tedlar bag.

Keywords*— Artificial electronic nose, breath analysis, diseases detection, exhaled breath, gas sensors, volatile organic compounds.

I. INTRODUCTION

Busy schedule in life, no physically hard work, not taking healthy food, no attention to own health. These were the main causes of various types of diseases like diabetes, kidney failure, lung diseases etc. Many dangerous diseases in humans are present but when symptoms appear on that time it means that the patient is in dangerous stage or in the last stage. Generally patient will die of the liver cancer after few months of detection. For detection of this type of diseases higher level of treatment (equipment and medicine etc.) needed to diagnose this type of diseases. But after all this type of treatment it is not efficient enough to treat this. This all are too costly for the patient. Many people cannot access this type of treatment. Breath is a collection of highly complicated molecular matrix, consist of both heavy chemical mixtures along with trace ingredients. The composition like nitrogen, carbon dioxide, oxygen, and water have very high percent is present in breath. We have more than thousand VOC's (volatile organic compounds) present in our breath in very low concentration. Some Volatile Organic Compounds are the markers of diseases present in human because if diseases present in human then it release the some marker substances in breath. That's why researchers are more interested to develop a detection method which is based on volatile organic compound. The finding recommend that different types of physical condition gives the various types of chemical compound indicator in breath, which express the physical condition of each persons. Patient with asthma have increase the level of nitric oxide in their breath, patient with renal diseases have ammonia, patient with liver diseases have sulphides in their breath, patient with diabetes have acetone in their breath, patient with cirrhosis diseases have aliphatic acid, patient with kidney failure have dimethylamine and trimethylamine in their breath and patient with lung cancer have substances like aldehydes, alkanes and derivatives of benzene in their breath.

The breath odour exhaled from human body in the form of volatile organic compounds which can be detect and analyze by many methods like Gas chromatography with mass spectrometry or GC/MS, solid phase micro extraction (SPM) and many other method for volatile organic compounds detection. Mainly in past studies they target on the detection of breast cancer, lung cancer etc. Recently the asthma detection and heptocellular carcinoma on using electronic nose has been published. This paper structured as follows:

In section 2 we discussed the work closely related to us, in section 3 we discussed the device or the work which is done by us. In section 4 results is given and at last conclusion and future scope is given.

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II. RELATED WORK

Nowadays, research on olfactory system becomes vast, specially cause of vast area of its applications in which it is used successfully. The olfactory signals and the signal determinate through human senses, transfers more valuable data than human beings are capable to sense, and electronic nose is a equipment which acquire such type of signals. Odour usually specified by five parameters which are 1) intensity, 2) degree of offensiveness, 3) characters, 4) frequency, and 5) duration.

Odor detection in artificial electronic nose is same as human sense the smell based therefore, it is works as other senses like perceiving, feeling by skin and listening etc. The concept of this smell olfactory structure simulates the neurobiological information proceeding setup. In both olfactory bulb and in the olfactory cortex gathered olfactory useful data is proceeding. The objective of the cortex is to perform the pattern analysis and detection of the odours. After the determination of odor, its useful data is transmitted to cerebral cortex, hippocampus and limbic system. In this stage, the responsiveness of the smell and how to react on it show up [7]. To fabricate such technique, electronic noses have been designed. The primary components of such noses are the sensing and the pattern identification components. The first section consists of multi type of sensors along with chemical, gas and many other analyze in a selective way through a chemical reaction. The second part, pattern analysis, is the discovering of regular and irregular patterns out of a given objective [7].

Artificial e-nose is a sensing device which sense the odor and it is based on combination of chemical gas sensors functioning as an array. The working of an artificial electronic nose is same as olfactory system in human that confide on analyze patterns and comparison between the odors. The primary components of artificial electronic nose are, a sample delivery system, a array of eight metal oxides and used to recognize the detection system and a computing system. According to the writers of this paper sample delivery system consists many parts like sample container, switching system controlled, gas flow path and a mass flow controller. The detection part have four types of elements to design a sensor and computing system consist two components Data acquisition and software [6]. According to the previous published Journal and papers there has been designed electronic nose which detect lung cancer by using exhaled breath. In this journal there is using statistics for analyzing the data [2]. According to this paper an electronic nose is to discriminate the spices and to analyze the exhaled breath of smokers and non-smokers is to measure the result in statistically the principle component analysis and linear discriminant function analysis was performed in combination with each other. A preciseness of classification of 100% was accomplished between spices and between breath samples from smokers and non-smokers. Gas spectrometry/Mass spectrometry were used for gas component analysis. Therefore, the analysis of breath via electronic nose is the present to medical applications such as recognizing and examining of conspicuously lung diseases [3]. According to the Saumya J. Shelat, Prof. H. K. Patel et all they designed electronic nose to detect the asthma using exhaled breath by analyzing the nitric oxide in human breath. There were using Nitric oxide which defines the person that is asthmatic or not. In this sample takes with the help of mask on mouth they takes breath for sample then there is processing as just like electronic sensor device sensor array, signal processing, feature extraction, classification and then result in classes. This integrated noninvasive approach will translate into an early diagnosis of asthma has to be clarified [4]. An electronic nose designed for detection of the lung cancer using Volatile in the exhaled breath. For designing this type of electronic nose author developed commercial gas sensor

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difference of human breath between patients with hepatocellular carcinoma (HCC) and healthy person. As a preparatory study, it was analyze that the electronic nose which was designed in laboratory is capable of differentiate the exhaled breath of the HCC patients from normal people. The outcomes acquired from this type of study may meet many more convenience for electronic nose for medical use in early diagnosis of liver cancer. It also overlays the way to the development of new sensors that can detect more precisely the odour particles correlated to liver cancer [5]. Another paper writer proposed an electronic nose which gives the status of the health of human. In this they were research to detect liver cancer and gives the health status of humans. In this, electronic nose system using four types of gas sensors was developed namely cumene PSMA/SWNT-COOH, Cu TPP/SWNT-COOH and MnTPP/SWNT-COOH for healthcare applications. The fabricated arrays of chemical gas sensors are capable of analyze the volatile organic compounds in breath odour. Principal Component Analysis results divulge differentiate between the patient and healthy people. Conversely, the sensors and dimensions system are still at the initial phase [6].

III. OVERVIEW OF DEVICE(ELECTRONIC NOSE)

An artificial electronic nose is a device that is designed which works like natural nose. According to definition, it uses a sensor array which detects the simple or complex odour and discriminate also that complex odour. And it has appropriate pattern recognition. Due to this electronic nose can be used to investigate the substances formed and excrete from the human breath or body searching, quickly and specifically, different diseases.

Artificial electronic nose setup consist of three state (1) volatile substances collection or breath collection, (2) examining or sample delivery system and (3) data analysis.

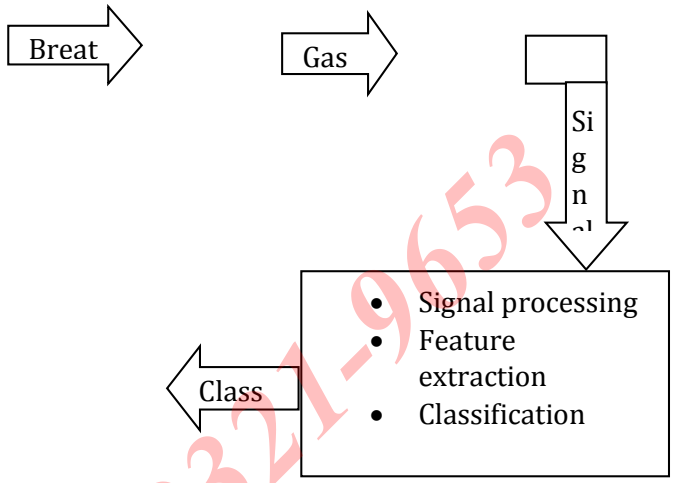


Fig: 1 Circuit diagram of Artificial Electronic nose [4]

In the first step breaths into a volatile sampling bag or breath sampling bag which is interject into a container having a sensor array where the interaction between the breath or volatile organic compounds and a sensor arrays are compute by computation circuit. These indicators distilled and intensified which transmitted to the computer for filter testing. The second step is examining the signal or detection system discriminating the signal which contained a dynamic feedback for intending the interaction between breath sample and the sensing material, chemical sensor which forms array of sensor in the signal computation module hardware structure. The gas molecules are sensed by the sensor and originate electronic signals. This signals are further distilled, amplified, digitized and forward to the computer for abstraction and analysis.

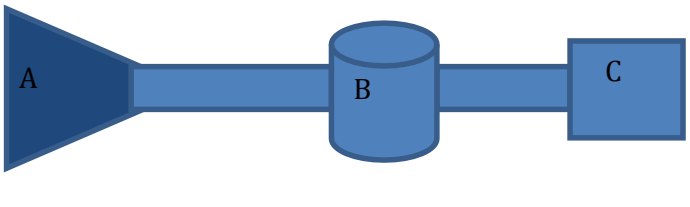
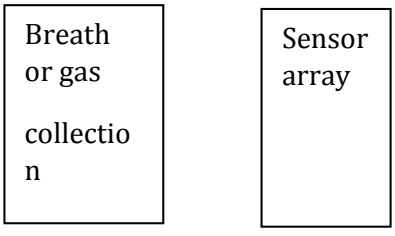


Fig: 2 Breath collection bag



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Breathe Collection:- According to the figure (2) the first point is breath collector bag (A), aqua vapor filter (B) in which there is hygroscopic substantial filled which absorbs the aqua vapor from the exhale breath, and third point (C) is removable part.

Different volatile organic compounds of breath have different sampling structure and different condition. Diabetes patient have acetone which is alveolar air, the person which have renal diseases have ammonia which is a dead space air. The asthmatic person have nitric oxide which is from dead space are in airway inflammation.

Different air or breath is collected in different ways like alveolar air is taken in different way and dead space is collect in different ways. For collecting the alveolar air a person have to take deep breath before breathing into the tedlar bag sample. The first collected breath is rejected or will not be used because it can be rejected.

This process is associable to a person having renal diseases or we can say who have airway inflammation, and there is no essential for the person to exhale. This process can be tested to a patient having diabetes. Pumps collect the dead space air which draws the breath from person's mouth to a tedlar sampling bag component (b) is a pump which is shown in figure (2).

Data Analysis: - In human breath numerous volatile organic compound present the large composition is oxygen, carbon dioxide, water vapor, and many other volatile organic compounds. The volatile organic compounds in human breath varies from person to person but approximately small familiar amount of breath, which are exist in all persons.

IV. RESULTS & DISCUSSION

The artificial electronic nose can detect the different types of diseases by the help of group of sensors on using different volatile organic compound present in exhale breath in humans. On comparing the volatile organic compounds which are predefine and recognize the diseases which are related to that voc's such as asthma can detect with the help of nitric oxide, similarly diabetes can detect with the help of aliphatic acid. Artificial electronic nose can give the result quick and in low cost. Artificial electronic nose can be used in hospitals and in medical area. It can also use in plants and in agriculture to detect their diseases and infections. Further artificial electronic nose also used in wireless sensor network in many areas.

V. CONCLUSION & FUTURE SCOPE

In this paper, there is survey of artificial electronic nose system based on array of gas sensor sense the volatile organic compounds and discriminate with patient of certain predefine diseases to healthy person on using some sample and patterns. Mostly diseases release some markers when it appears, before symptoms appear. In the initialization stage also they release some markers which can be detects from our breath on using sensor by the help of artificial electronic nose. An artificial electronic nose can detect the diseases in less time and low cost people does not have to wait for more time result and not have to invest more money to diagnose dangerous diseases. With the help of this device a person cannot have to go for daily routine checking to clinic or hospital. And a normal family also can safe from dangerous diseases. In the previous paper in all electronic nose were designed which can detect individual the one or small number of diseases and I want to design an artificial electronic nose which can detect the maximum number of diseases. Future research can be on the improving the sample quality or noise free breath sample collection. It should be on, that more testing systematically or step by step on using many methods like using larger number of patient at different stage of higher diseases. And research should be on, that maximum number of diseases detect using one electronic sensor device or on using minimum number of sensors.

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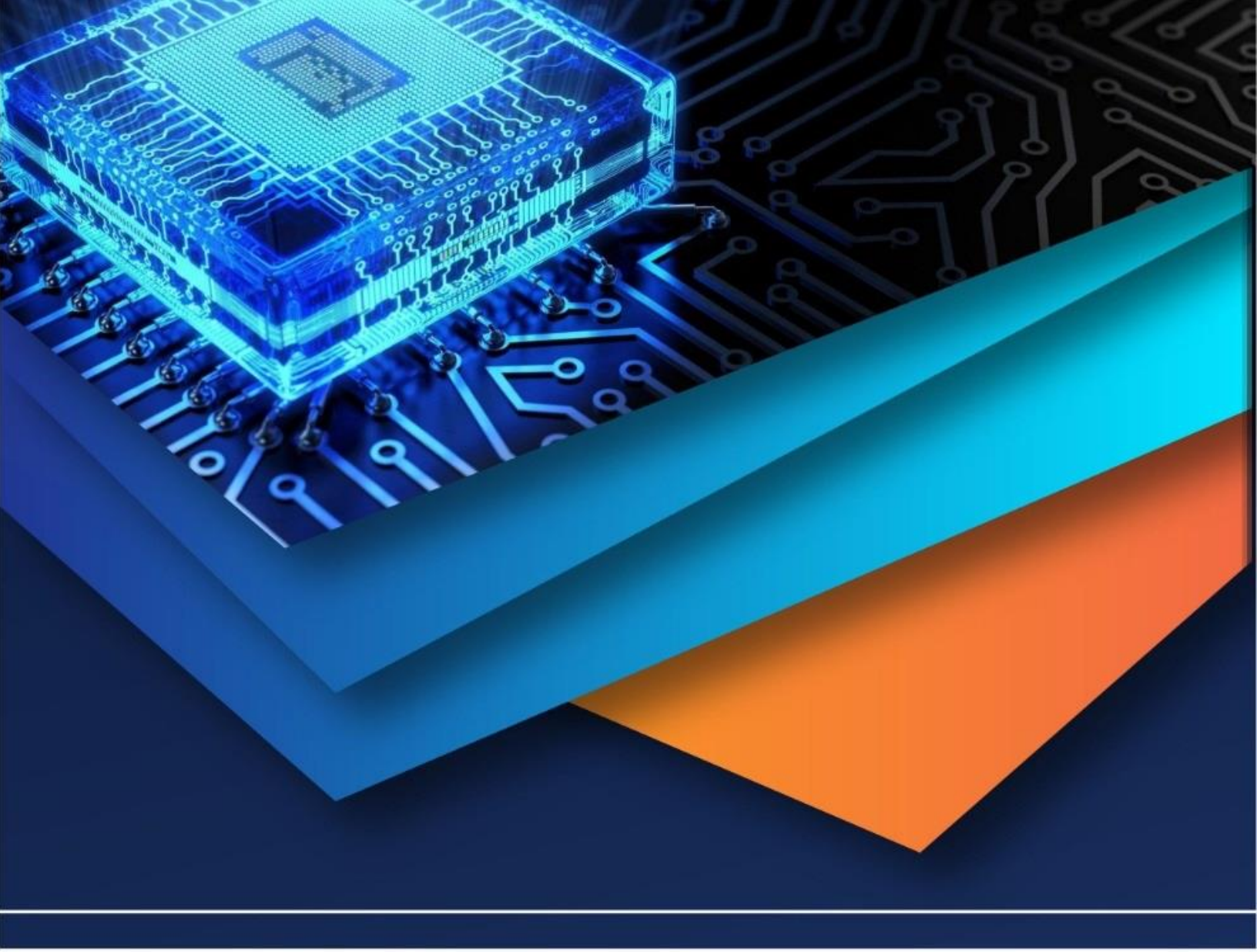

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