INTRODUCTION

The electronics field is developing at a fast rate. Each day the industry is coming with new technology and products. The electronic components play a major role in all fields of life. The scientists had started to mimic the biological world. The development of artificial neural network (ANN), in which the nervous system is electronically implemented is one among them.

The scientists realized the importance of the detection and identification of odor in many fields. In human body it is achieved with the help of one of the sense organ, the nose. So scientists realized the need of imitating the human nose. The concept of the electronic nose appeared for the first time in a nature paper by Persuade and Dodd (1982). The authors suggested and demonstrated with a few examples that gas sensor array responses could be analyzed with artificial neural networks thereby increasing sensitivity and precision in analysis significantly. This first publication was followed by several methodological papers evaluating different sensor types and combinations.

The scientists saw the last advances in the electronic means of seeing and hearing. Witnessing this fast advances they scent a marker for systems mimicking the human nose. The harnessing of electronics to measure odor is greatly desired. Human panels backed by gas chromatography (GC)/ mass spectroscopy (MS) are helpful
in quantifying smells. The human panels are subject to fatigue and inconsistencies. While classical gas chromatography (GC)/mass spectrograph (MS) technique separate quantify and identify individual volatile chemicals, they cannot tell us if the components have an odour. Also they are very slow. So it is important that faster methods must give way to speedier procedure using an electronic nose composed of gas sensory. The E-nose was developed not to replace traditional GC/MS and sensory techniques. The E-nose was sensitive and as discriminating as the human nose, and it also correlates extremely with GC/MS data. The electronic nose allows to transfer expert knowledge from highly trained sensory panels and very sophisticated R&D analytical techniques to the production floor for the control of quality. Although the human nose is very sensitive, it is highly subjective. The E – nose offers objectivity and reproducibility.

The electronic nose technology goes several steps ahead of the conventional gas sensors. The electronics nose system detects and sensing devices with pattern recognition sub system. The electronic nose won quickly considerable interest in food analysis for rapid and reliable quality classification in manufacturing testing. Later, the electronic noses have also been applied to classification of microorganisms and bio-reactor monitoring. Even though the electronic nose resembles its biological counterpart nose too closely the label “electronic nose” or “E-nose” has been widely accepted around the world.
THE BIOLOGICAL NOSE

To attempt to mimic the human apparatus, researchers have identified distinct steps that characterize the way humans smell. It all begins with sniffing, which moves air samples that contain molecules of odors past curved bony structures called turbinate. The turbinate create turbulent airflow patterns that carry the mixture of volatile compounds to that thin mucus coating of the nose’s olfactory epithelium, where ends if the nerve cells that sense odorants.

The volatile organic compounds (VOCs) basic to odors reach the olfactory epithelium in gaseous form or else as a coating on the particles that fill the air we breathe. Particles reach the olfactory epithelium not only from the nostrils but also from the mouth when food is chewed.

As VOCs and particles carrying VOCs pass over the mucus membrane lining the nose, they are trapped by the mucus and diffuse through to the next layer, namely, the epithelium, where the sensory cells lie in wait. The cells are covered in multiple cilia- hair like structures with receptors located on the cells outer membranes. Olfactory cells are specialized neurons that are replicated approximately every 30 days.
The transformation of a molecule into an odor begins when this odorant molecule, as it is called, binds to a receptor protein. The event initiates a cascade of enzymatic reactions that result in depolarization of the cell’s membrane. (Ion pumps within the cell’s membrane keep the cell polarized in its rest, or steady state, with a typical rest potential of about 90 mV across the membrane). There are more than 100 million protein receptors in all and perhaps 1000 types. For example, one receptor type is sensitive to a small subset of odorants, one of which is the organic compound octanal.

The sensory cells in the epithelium respond by transmitting signals along neural “wires” called axons. Such an axon first traverses a small hole in a bony structure in the base of the skull, known as the cribriform plate. Then the rest of the neuron wends its way to the brain’s olfactory bulb, where it terminates in a cluster of neural networks called glomeruli.

The 2000 or so glomeruli of the olfactory bulb represent the first tier of central odor information processing. All sensory neurons containing a specific odor receptor are thought to converge on two or three glomeruli in the olfactory bulb. Note that olfactory sensory neurons in the epithelium can each respond to more than one odorant. It is therefore the pattern of response across multiple glomeruli that codes olfactory quality.
Olfactory information ultimately arrives higher up in the brain, first at the hypothalamus, which also processes neural signals related to food intake, and then at still higher processing centres. The use of noninvasive techniques to study the brain suggests that different chemical stimuli activate different brain regions to different degrees.

As the new electronic technology emerges, conventional approaches to measuring odor are challenged. As noted earlier, current methods generally involve either the use of human odor panel to quantify and characterize the odor or gas chromatography and mass spectrometry to precisely identify the odorants producing it.

The concentration of an odor may be expressed as a multiple of either its detection on its recognition threshold. The recognition threshold is defined by the American Society for Testing and Materials (ASTM) as the lowest concentration at which an odor is first detected recognition is no necessary – by 50% of human sniffing it. The detection threshold is considered the absolute threshold of sensation for an odor. The odor concentration at this threshold is defined to be 1.0 odor unit / m3. The value is established by averaging the responses over a population of individuals.
Panels of trained human “sniffers” are the gold standard of odor measurement. The recognition threshold is defined by ASTM as the lowest concentration at which an odor is first identified by 50% of the population sniffing an odorant. In this case, the recognition threshold is often 5-10 odor units or 5-10 times as high as the detection threshold.

Gas chromatography and mass spectrometry have also been used to identify the chemical constituents of an odorous mixture. Air samples are collected in special canisters or bags and taken to the laboratory for analysis afterward. The odorant may be concentrated in the field or laboratory by using a vapor trap consisting of an absorbent maternal or cryogenic device.

In either case, a measured volume of the sample is forced through the trap where odorant molecule are removed from the gas sample and collected on the absorbent material or cryogenic surface. Heating the trap releases the concentrated molecules rapidly into the gas chromatography. Borne along on a small volume of a pure carrier gas, which flows through the column at a constant rate, the sample passes through the column to a detector.
**ELECTRONIC NOSE PRINCIPLES**

Enter the gas sensors of the electronic nose. This speedy, reliable new technology undertakes what till now has been impossible – continuous real monitoring of odor at specific sites in the field over hours, days, weeks or even months.

An electronic device can also circumvent many other problems associated with the use of human panels. Individual variability, adaptation (becoming less sensitive during prolonged exposure), fatigue, infections, mental state, subjectivity, and exposure to hazardous compounds all come to mind. In effect, the electronic nose can create odor exposure profiles beyond the capabilities of the human panel or GC/MS measurement techniques.

The electronic nose is a system consisting of three functional components that operate serially on an odorant sample- a sample handler, an array of gas sensors, and a signal processing system. The output of the electronic nose can be the identity of the odorant, an estimate of the concentration of the odorant, or the characteristic properties of the odor as might be perceived by a human.

Fundamental to the artificial nose is the idea that each sensor in the array has different sensitivity. For example, odorant No. 1 may produce a high response in
one sensor and lower responses in others, whereas odorant No. 2 might produce high readings for sensors other than the one that “took” to odorant No.1.

What is important is that the pattern of response across the sensors is distinct for different odorants. This distinguishability allows the system to identify an unknown odor from the pattern of sensor responses. Each sensor in the array has a unique response profile to the spectrum of odorants under test. The pattern of response across all sensors in the array is used to identify and/or characterize the odor.

**Sensing an odorant**

In a typical electronic nose, an air sample is pulled by a vacuum pump through a tube into a small chamber housing the electronic sensor array. The tube may be made of plastic or a stainless steel. Next, the sample-handling unit exposes the sensors to the odorant, producing a transient response as the VOCs interact with the surface and bulk of the sensor’s active material. (Earlier, each sensor has been driven to a known state by having clean, dry air or some other reference gas passed over its active elements.) A steady state condition is reached in a few seconds to a few minutes, depending on the sensor type.
During this interval, the sensor’s response is recorded and delivered to the signal processing unit. Then, a washing gas such as an alcohol vapor is applied to the array for a few seconds to a minute, so as to remove the odorant mixture from the surface and bulk of the sensor’s active material. (Some designers choose to skip this washing step) Finally, the reference gas is applied to the array, to prepare it for a new measurement cycle. The period during which the odorant is applied is called the response time of the sensor array. The period during which the washing and reference gases are applied is termed the recovery time.

**ELECTRONIC NOSE SENSORS**

Electronic nose sensors fall in four categories:-

- Conductivity Sensors
- Piezo Electric Sensors
- MOSFET Sensors and,
- Optical Sensors.

**CONDUCTIVITY SENSORS**

There are two types of conductivity sensors.

a. Metal Oxide Sensor  
b. Polymer Sensor  
Both of them exhibit a property of change in assistance when exposed to volatile organic compounds.
a. Metal Oxide Sensor

Metal Oxide Semi conductor sensors have been used more extensively in electronic nose instruments and are widely available commercially. Typical metal Oxide sensors include oxides of tin, zinc, titanium, tungsten and Iridium doped with a noble metal catalyst such as platinum or palladium. The doped semi conducting material with which the VOCs interact is deposited between two metal contacts over a resistive heating element, which operates at 200°C to 400°C. At these elevated temperature, heat dispersion becomes a factor in the mechanical design of the sensing chamber. Micro machining is often used to thin the sensor substrate under the active material, so that power consumption and heat dissipation requirements are reduced. As a VOC passes over the doped oxide material, the resistance between the two metal contacts changes in proportion to the concentration of the VOC.
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The recipe for the active sensor material is designed to enhance the response to specific odorants, such as carbon monoxide or ammonia. Selectivity can be further improved by altering the operating temperature. Sensor sensitivity ranges from 5 to 500 parts per million. The sensor also respond to water, vapor, more specifically to humidity differences between the gas sample being analyzed and a known reference gas used to initialize the sensor.

The baseline response of metal oxide sensors is prone to drift over periods of hours to days, so signal processing algorithms should be employed to counteract this property. The sensors are also susceptible to poisoning (irreversible binding) by sulphur compounds present in the odorant mixture. But their wide availability and relatively low cost make them the most widely used gas sensors today.

b. Polymer Sensor

Conducting polymer sensors, a second type of conductivity sensor, are also commonly used in electronic nose systems. Here, the active material in the above figure is a conducting polymer from such families as the polypyrroles, thiophenes, indoles or furans. Changes in the conductivity of these materials occur as they are exposed to various types of chemicals, which bond with the polymer backbone. The bonding may be ionic or in some
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cases, covalent. The interaction affects the transfer of electrons along the polymer chain, that is to say its conductivity is strongly influenced by the counter–ions and functional groups attached to the polymer backbone.

In order to use these polymers in a sensor device, micro fabrication techniques are employed to form two electrodes separated by a gap of 10 to 20 micrometre. Then the conducting polymer is electro polymerized between the electrodes by cycling the voltage between them. For example, layers of polypyrroles can be formed by cycling between -0.7 and +1.4 V. Varying the voltage sweep rate and applying a series of polymer precursors yields a wide variety of active materials. Response time is inversely proportional to the polymer's thickness. To speed response times, micrometer–size conducting polymer bridges are formed between the contract electrodes.

Because conducting polymer sensors operated at ambient temperature, they do not need heaters and thus are easier to make. The electronic interface is straightforward, and they are suitable for portable instruments. The sensors can detect odors at sensitivities of 0.1 parts per million (ppm), but 10 to 100 ppm is more usual.

The main drawback of existing conducting polymer sensor is that it is difficult and time consuming to electro polymerize the active material, so they exhibit undesirable variations from one batch to another. Their responses also
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drift over time and they are usually greater sensitivity than metal oxides to water vapor renders them susceptible humidity. This susceptibility can mask the responses to odorous volatile organic compounds.

In addition, some odorants can penetrate the polymer bulk, dragging out the sensor recovery time by slowing the removal of the VOC from the polymer. This extends the cycle time for sequentially processing odorant samples.

**PIEZO ELECTRICAL SENSORS**

The Piezoelectric family of sensors also has two members: quarts crystal microbalance (QCM) and surface acoustic-wave (SAW) devices. They can measure temperature mass changes, pressure, force and acceleration but in the electronic once, they are configured as mass-change-sensing device.

**a) QCM SENSOR**

- Odorant
- Electrodes
- Polymer Coating
- Quartz Disc
The QCM types consist of a resonating disk a few millimeters in diameter, with metal electrodes on each side connected to dead wise. The device resonate at a characteristic frequency (10MHz to 30MHz) when excited with an oscillating signal.

During manufacture, a polymer coating is applied to the disk-polymer, device and thereby reducing the resonance frequency. The reduction is inversely proportional to odorant mass absorbed by the polymer for example; a 166um-thick quartz crystal cut along a certain axis will resonate at 10 MHz positive 0.01 percent change in mass, a negative shift of 1 KHz will occur in its resonance frequency. Then when the sensor is exposed to a reference gas, the resonance frequency returns to its baseline value.

A good deal is known about QCM device. The military for one has experimented with them for years, using them for one detection of trancer amounts of explosive and other hazardous compounds and measuring mass changes to a resolution of 1 picogram. For example, 1pg of methane in a 1 liter sample volume at standard temperature and pressure produces a methane concentration of 1.4ppb.

In addition, QCM sensors are remarkably linear once wide dynamic range. Their response to water it dependent upon the absorbent material employed. And their
sensitivity to changes in temperature can be made negligible.

Tailoring the QCM for specific application is done by adjusting its polymer coating. Fortunately, a large number of coating its available from those developed of GC Column. The response and recovery times of the resonant structure are minimized by reducing size and mass of the quartz crystal along with the thickness of the polymer coating. Batch-to-batch variability is not a problem because these device measure normalized frequency change, a differential measurement that removes common-mode-noise.

Care must be taken when making three dimensional devices by micro electromechanical system (MEMS) processing techniques. When the dimensions are scaled down to micrometer levels, the surface to volume ratios increase, and the larger the surface-to-volume ratio; the noiser the device gets because of surface processes that cause instabilities. Hence, signal-to-noise ratio degrades with increasing surface-to volume ratio, thereby hampering measurement accuracy. It should be noted that this phenomenon applies to most micro fabricated devices.
b) SAW SENSOR

The Saw Sensor differs from QCMs in several important ways. First, a Rayleigh (Surface) wave travels over the surface of the device; not throughout its volume. SAW sensors operate at much higher frequencies, and so can generate a larger change in frequency. A typical SAW device operates in the hundreds of megahertz, while 10MHz is more typical for a QCM, but SAW device can measure changes in mass to the same order of magnitude as QCMs. Even though the frequency range is larger, increased surface-to-volume ratios mean the Signal-to-noise ratio is usually poorer. Hence, SAW device be less sensitive the QCMs in some instances.

Being planar, SAW device can be fabricated with photolithographic methods developed by the micro electronics industry. The fact that there dimensional
MEMS processing is unnecessary makes them relatively cheaper than their QCM counterparts when large quantities are produced.

Being planar, SAW device can be fabricated with photolithographic methods developed by the microelectronics industry. The fact that there dimensional MEMS processing is unnecessary makes them relatively cheaper than their QCM counterparts when large quantities are produced.

As with QCMs, many polymer coatings are available, and as with the other sensor types, differential measurements can eliminate commonmode effects. For example, two adjacent SAW devices on the same substrate (one with an active membrane and another without) can be operated as a differential pair of remove temperature variations and power line noise.

A disadvantage of both QCM and SAW device is more complete electronics than are needed by the conductivity sensors. Another is their need for frequency detectors, whose resonant frequencies can drift as the active membrane ages.

**MOSFET SENSORS**

MOSFET odor sensing device are based on the principle that VOCs in contact with a catalytic metal can
produce a reaction in the metal and the reaction’s products can diffuse through the gate of the MOSFET to change the electrical properties of the device. A typical MOSFET structure has p-type substrate with two n doped regions with metal contacts labeled source and drain as shown in fig.

The sensitivity and selectivity of the device can be optimized by varying the type and thickness of the metal catalyst and operating them at different temperatures. MOSFET sensors have been investigated for numerous applications; but to date few have been used in commercial electronic nose systems because of a dearth of sensors variants.

The advantages of MOSFETs is that they can be made with 1C fabrication processes, so that batch to batch variation can be minimized. The disadvantages is that the catalyzed reaction products such as hydrogen must penetrate the catalytic metal layer in order to influence
that charge at the channel, so that the package must therefore have a window to permit gas to interact with the gate structure on the IC chip. Thus it is important to maintain a hermetic seal for the chip’s electrical connections in harsh environments. The requirements may be satisfied by using photo-definable polymers such as polymide, to seal all areas of the chip that are not to be intentionally exposed to the environment. MOSFET sensors also undergo baseline drift similar to that of conductivity sensors.

**OPTICAL SENSORS**

Optical fiber sensors, yet another type, utilize glass fibers with a thin chemically active material coating on their sides or ends as shown in Fig. A light source at a
single frequency (or at a narrow band of frequencies) is used to interrogate the active material, which in turn responds with a change in color to the presence of the VOCs to be detected and measured.

The active materials contain chemically active fluorescent dyes immobilized in an organic polymer matrix. As VOCs interact with it, the polarity of the fluorescent dyes is altered and they respond by shifting their fluorescent emission spectrum. When a pulse of light from an external source interrogates the sensor, the fluorescent dye responds by emitting light a different frequency. As the source intensity is much greater than sensor response great care must be taken to ensure that the response photodetectors are protected from the source emissions.

Favoring the optical sensors is the availability of many different dyes of biologic research, so that the sensors themselves the cheap and easy to fabricate. It is also possible to couple fluorescent dyes to antibody antigen binding (the recognition of a specific molecule, and only that molecule, as in the human immune system). Thus an array of fiber sensors can have wide range sensitivities, a feature not easily obtained with other sensor types. As with other types, differential measurements can also be used to remove common mode noise effects. In their disfavor are the complexity of the instrumentation control system, which adds to fabrication
cost, and their lifetime due to the photobleaching. The sensing process slowly consumes the fluorescent dyes, the way sunlight bleaches fabric dyes.

**SIGNAL PROCESSING AND PATTERN RECOGNITION**

The task of an electronic nose is to identify an odorant sample and perhaps to estimate its concentration. The means are signal processing and pattern recognition. For an electronic nose system this two steps may be subdivided into four sequential stages. They are preprocessing, feature extraction, classification and decision-making. But first a data base of the expected odorant must be compiled, and sample must be presented to the nose’s sensor array.

Preprocessing compensates for sensor drift compress the transient response of the sensor array, and reduces sample to sample variations. Typical techniques are manipulation of sensor base lines, normalization of sensor response ranges of all the sensors in an array (the normalization constant may some times be used to
estimate the odorant concentration), and compression sensor transients.

Feature extraction has two purposes; they are to reduce the dimensionality of the measurement space, and to extract information relevant for pattern recognition. To illustrate, in an electronic nose with 32 sensors, the measurement space has 32 dimensions. This space can cause statistical problem if odor database contains only a few examples, typical in pattern recognition applications because of the cost of data collection. Furthermore, since the sensors have overlapping sensitivities there is high degree of redundancy in these 32 dimensions. Accordingly is it convenient to project the 32 on to a few informative and independent axes. This low dimensional projection (typically 2 or 3 axes) has the added advantage that it can be more readily inspected visually.

Feature extraction is generally performed with linear transformations such as the classical principal component analyses (PCA) and linear discriminate analysis (LDA). PCA finds projections of maximum variance and is the most widely used linear feature extraction techniques. But it is not optimal for classification since it ignores the identity (class label) of the odor examples in the database.

LDA, on the other hand, looks at the class label of each example. Its goal is to find projections that maximize the distance between examples from different odorants yet
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minimize the distance between examples of the same odorant. As in example, PCA may do better with a projection that contain high variance random noise whereas LDA may do better with a projection that contain subtle, but maybe crucial, odor discriminatory information. LDA is therefore more appropriate for classification purposes.

Several research groups have recently adopted some nonlinear transforms, such as Sammon nonlinear maps and Kohonen self organizing maps. Sammon maps attempt to find a 2D or 3D mapping the preserves the distance between pairs of examples on the original 32 dimensional space. Kohonen maps project the 32 dimensional space onto a two dimensional mesh of processing elements called neurons.

Neighboring neurons are trained to respond to similar types of stimuli (odorants), a self organizing behavior motivated by neuro biological considerations. Neither of these techniques makes use of class labels, so they are not optimal for pattern classification. Once the odor examples have been projected on an appropriate low dimensional space the classification stage can be trained to identify the patterns that are representative of each odor, when presented with an unidentified odor, the classification stage will be able to assign to it a class label (identify the odorant) by comparing its pattern with those complied during training. The classical methods of
performing the classification task are K nearest neighbor (KNN) Bayesian classifiers, and Artificial Neural Network (ANN).

An Artificial Neural Network (ANN) is an information-processing paradigm that is inspired by the way nervous systems, such as the brain, process information. They key elements of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well. For the electronic nose, the ANN learns to identify the various chemical or odors by example. A typical ANN classifier consists of two or more layers of neurons that are connected with synaptic weights-real number multiplier that connect that output of neuron to the inputs of neurons in the next layer. During the training the ANN adapts the synaptic weights to learn the pattern of different odornants. After training when presented with an unidentified odorant the ANN feeds its pattern through the different layers of neurons and assigns the class label that provides the largest response.
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ANNs have been applied to and increasing number of real world problems of considerable complexity. Their most important advantage is in solving problems that are too complex for conventional technologies; that is problems that do not have an algorithmic solution or for which an algorithmic solution is too complex to be found. In general, because of their abstraction from the biological brain, ANNs are well suited to problems that people are good at solving but computers are not. These problems include pattern recognition and forecasting. However, unlike the human capability in pattern recognition, The ANNs capability is not affected by factors such as fatigue, working conditions, emotional state and compensation.

**ELECTRONIC NOSE INSTRUMENTATION**

General measurement system
The basic element of a generalized electronic instrument system to measure odours are shown schematically in the figure. First there is an odour from the source material to the sensor chamber.

There are tow main ways in which the odour can be delivered to the sensor chamber, namely head space sampling and flow injection. In head space sampling, the head space of an odorant material is physically removed from a sample vessel and inserted into the sensor chamber using either a manual or automated procedure. Alternatively, a carrier gas can be used to carry the odorant from the sample vessel into the sensor by a method called flow injection. The sensor chamber houses the array of chosen odour sensors, e.g. Semi conducting polymer chemo resisters, etc. The sensor electronic not only convert the chemical signal into an electrical signal but also, usually, amplify and condition it. This can be done using conventional analogue electronic circuitry (e.g. operational amplifiers) and the output is then a set of an analogue outputs, such as 0 to 5v d.c. although a 4 to 20mA d.c. current output of preferable if using a long cable. The signal must be converted into a digital converter (e.g. a 12 – bit converter) followed by a multiplexer to produce a digital signal which either interfaces to a serial port on the microprocessor (e.g. RS - 232) or digital bus (e.g. GPIB). The microprocessor (e.g. an Intel 486 or Motorola 68HC11) is programmed to carry out a number of tasks.
APPLICATIONS

The electronic nose finds lot of application in many fields. They have been used in a variety of applications and could help solve problems in many fields including food product quality assurance, health care, environmental monitoring, pharmaceuticals etc. The major applications are

FOOD INDUSTRY APPLICATION

Currently, the biggest market for electronic nose is in the food industry. In some instances electronic noses can be used to augment or replace panels of human experts. In food production especially when qualitative results will do. The applications of electronic noses in food industry are numerous. They include.

- Inspection of food by odour
- Grading quality of food by odour
- Fish inspection
- Fermentation control
- Checking mayonnaise for rancidity
- Automated flavor control
- Monitoring cheese ripening
- Beverage container inspection
- Grading whiskey
- Microwave over cooking control
MEDICAL APPLICATIONS

Since the sense of smell is an important sense it the physician, an electronic nose has applicability as a diagnostic tool. An electronic nose can be used to analyze the odours from the body and identify the possible problems. Odour in the breath can be indicative of gastrointestinal problems, sinus problem, infection, diabetes, liver problems etc, infected wounds and tissues will emit distinctive smell, which can be detected by the electronic nose. Odours coming from the body fluids such as blood and urine can indicate liver and bladder problems.

The electronic nose will give the doctor a sixth sense. By sensing the smell of the breath doctor will be able to identify the disease. As an example, it is found that the fruity, nail-varnish remover smell found of the breathe of a diabetic about to enter a sever coma. The tin traces of illness-related chemicals on your breath could indicate diseases such as schizophrenia when detected by a new generation of electronic noses.

ENVIRONMENTAL MONITORING

The environmental applications of the electronic nose will include
• Identification of toxic wastes.
• Analysis of fuel mixtures.
• Detection of oil leaks.
• Identification of household odours.
• Monitoring air quality.
• Monitoring factor emission.

PHARMACEUTICAL INDUSTRY APPLICATIONS

In the pharmaceutical industry the electronic nose could be used to screen the incoming raw materials, monitor production process, maintain security in storage and distribution areas, quality assurance, testing the employees in critical occupations for drug use or abuse, use to detect unpleasant smell in the industrial area.

SAFETY AND SECURITY APPLICATION

The electronic nose can help in the safety and security applications. They include
• Hazardous alarms for toxic and biological agents
• Screening airline passengers for explosive
• Examining vehicles for drugs.
• Monitoring indoor air quality.
• Smart fire alarms.
• Fire alarms in nuclear plants.
• Biological and chemical detection in battlefield.
CONCLUSION

In the seminar, it is mentioned more accurately termed electronic arrays for chemical sensing and identification. In this quick tour of the route from molecule to smell, it is helpful to correlate many of the discrete physiological steps with engineering ones ranging from sampling, signal processing and application all the way to neural computation.
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ABSTRACT

The harnessing of electronics to measure odor is greatly to be desired. Human panels backed up by gas chromatography and mass spectrometry are helpful in quantifying smells, but they time are consuming, expensive and seldom performed in real time in the field. So it is important that these traditional methods give way to a speedier procedure using and electronic nose composed of gas sensors. Electronic nose or E-noses are the systems that detect and identify odours and vapours, typically linking chemical sensing devices with signal processing, pattern recognition and artificial intelligence techniques which enable users to readily extract relevant and reliable information.
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