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# Protection of Industrial emission, Forest fire and Ecological disaster using nWSN in Smart World by Green IoT Applications: A Techno-socioeconomic aspects

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**ABSTRACT**: Now a day's numerous applications of Green Internet of Things (G-IoT) are socio-economically and techno-legally, environmentally and sustainability, preserving natural resources and improving human health, forest wildlife, biodiversity loss and industry provides effective insight research in the field of the current statuses and future promises of the G-IoT. This research has as main goal to evaluate the feasibility of a Next Generation Nanostructured Wireless Sensor Network System (n-WSN) as G-IoT application for forest fire and industrial emissions monitoring and ecological disaster protection. Although there has been immense development of more sensitive and selective nanostructured sensor arrays and Artificial Intelligent (AI) enabling advanced data mining technology, there have been very few reports on the applications of electronic nose (e-Nose), electronic tongue (e-Tongue) and electronic vision (e-vision) for the measurement of industrial emissions gaseous, eco-logical disaster and forest fire protection and management. The current techno-legal and socio-economical and echno-legal research sheds light on the practical applicability of e-Nose for the effective industrial hazards gaseous like as volatile organic compound (VOC) emissions measurement, ecological disaster and forest fire protection and management.

**KEYWORDS**: GIoT, nWSN, AI, Industrial emissions, biodiversity loss, e-Nose. Techno-legal.

## I. INTRODUCTION

Current turbulent on the global economic, demographic, socio-economical and ecological context, governments, local administrative authorities, researchers and commercial companies or even individuals have to recognize the importance of the resources contained in the forest environment not only from the perspective of the biodiversity and industry not only for the human health and lives, but also from the point of view of the economic resources which forests enclose. Therefore, any major threat posed to this essential component of the environment should be identified, studied and fought through the most efficient and modern economic policies and technological means. Among them the most dangerous phenomena, which jeopardize forests, are represented by Forest and Industries, are represented by forest fires and industrial gaseous emissions. A forest fire is any form of unrestrained fire that erupts in a forested area. Forest fires have proven to be a massive form of destruction for humankind, especially when not countered through appropriate measures and strategies. The most important measures for fighting forest fires and industrial gaseous emissions are: (1) Prevention, (2) Prediction and (3) Suppression.

## II. BACKGROUND AND CONTEXT

The applications categorization is based on gaseous pollutants released from the industries. Calibration and transfer methodologies have been discussed to enhance the applicability of electronic nose (e-Nose) and electronic tongue (e-Tongue) and electronic vision (e-Vision) systems. This new solution for forest fire monitoring and protection could be targeted at both state and private organisations, which are located in regions where fires represent a threat. After a broad socio-economic and technical examination, the research will show tat this type of G-IoT system can offer an efficient approach for reducing economic and biodiversity loss, while helping to prevent human rights and casualties and vision to sustainable development goal (SDG) in a smart world. Olfaction is one of the five major human senses (vision, hearing, olfaction, taste, and touch). The sense of smell is the most mysterious and complex sense; a particular smell can trigger a series of memories in people. In 2004, Axel and Buck won the Nobel Prize in Physiology or Medicine for their research on “odorant receptors and the organization of the olfactory system” [1], which shows the interest and value of the research on olfaction. Artificial olfaction also called an electronic nose (e-nose) is a biomimetic olfactory system [2] that can replace well-trained experts in dangerous work, or surpass the limits of their abilities. Recently, artificial olfaction has been developed for numerous industry applications [3], such as indoor air-quality monitoring, medical care, customs security, food quality control, environmental quality monitoring, military applications, and hazardous gas detection, medical diagnosis [4], psychoanalysis, agriculture, pharmaceuticals, to name but a few [5]. The biological nose is an obvious choice for such applications, but there are some disadvantages to having human beings perform these tasks due to a variety of reasons such as fatigue, infections, mental state, subjectivity, exposure to hazardous materials, individual variables, etc., and generally it is socio-economically and technically unfeasible to invest a large amount of money in training for tasks that last a relatively short time. The earliest artificial olfaction device can be traced back to 1961, when Moncrieff proposed a mechanical artificial nose. The first electronic nose was developed by Wilkens, Hatman, and Buck in 1964 [6].

### (a) Sources and Chemical Properties of Methane ($CH_4$)

In nature, methane ($CH_4$) is produced by the anaerobic bacterial decomposition of vegetable matter under water (where it is sometimes called marsh gas or swamp gas). Methane is colourless, odourless gas that occurs abundantly in nature and as a product of certain human activities. Methane is the simplest member of the paraffin series of hydrocarbons and is among the most potent of the greenhouse gases. Wetlands are the major natural source of methane produced in this way. Other important natural sources of Methane include termites as a result of digestive processes, volcanoes, vents in the ocean floor, and methane hydrate deposits that occur along continental margins and beneath Antarctic ice and Arctic permafrost. Methane also is the chief constituent of natural gas, which contains from 50 to 90 percent methane (depending on the source), and occurs as a component of firedamp or flammable gas along coal seams. Methane in general is very stable, but mixtures of methane and air, with the methane content between 5 and 14 percent by volume, are explosive. Explosions of such mixtures have been frequent in coal mines and collieries and have been the cause of many mine disasters. Methane is lighter than air, having a specific gravity of 0.554. It is only slightly soluble in water. It burns readily in air, forming carbon dioxide and water vapour; the flame is pale, slightly luminous, and very hot.

### (b) Environmental Challenges, Constitution and National Policies

To address these environmental challenges in coordination with the state governments, the central government has identified and targeted 17 highly polluting industries and 24 environmental problem areas. The chemical and engineering industries are at the top of the government’s list, since they are the major contributors to air, water, and waste pollution. These industries include integrated iron and steel plants, non-ferrous metallurgical, pharmaceutical and petrochemical complexes, fertilizers and pesticide plants, thermal power plants, textiles, pulp and paper and tanneries units.

India took a bold step to include environmental protection rights and duties in its Constitution. The Constitution of India specifies that the State shall endeavour to protect and improve the environment and to safeguard the natural resources of the country. According to the Constitution, it is the fundamental duty of every citizen of India to protect and improve the natural environment and to have compassion for living creatures. By raising environmental concerns to the constitutional level, India has provided its citizens with a powerful policy tool to protect the environment.

**National Policies:** In addition to the Constitutional mandate, India has a number of national policies governing environmental management, including the National Policy on Pollution Amendment

(NPPA, 1992) and the National Conservation Strategy and Policy Statement on Environment and Development (NCS / PSED, 1992). While these national policies are not judicially enforceable, they serve as guiding principles for the central and state governments to follow.

The NPPA encourages the use of economic instruments to complement traditional command and control approaches to pollution abatement. To integrate environmental considerations into decision making at all levels, the policy adopts the following guiding principles:

- prevention of pollution at source;
- adoption of best available technology;
- the polluter pays principle; and
- public participation in decision making.

The NCS/PSED provides an overarching policy frame-work on environmental management, including conser-vation of natural resources and economic development. Key instruments for promoting environmental change include conducting environmental impact assessments, developing educational campaigns, and ensuring public participation.As the nodal agency, the Ministry of Environment and Forests (MOEF) is responsible for implementing the NPPA and the NCS / PSED.

## III. METHODS AND EXPERIMENTAL

### (a) Nanostructured Sensor based Electronic Nose (e-Nose)

Olfaction is one of the five major human senses (vision, hearing, smell, taste, and touch). The sense of smell is the most mysterious and complex sense; a particular smell can trigger a series of memories in people. A typical and prototype nanostructured electronic nose (e-Nose) is on lines parallel to the human nasal system working in coordination with the brain. Figure 1. Shows comparison of the sense of smell and taste with artificial senses. Whenever the ortho-nasal pathway sniffs a compound, it reaches the olfactory epithelium located in the upper nasal cavity. There the interactions of odorants with the appropriate chemosensory receptors take place, and the olfactory neurons of different classes produce electrical stimuli, which are transmitted to the brain [6]. A pattern recognition process assisted by the memory then takes place using all the data to identify, classify, or perform a hedonic analysis. Evidence exists showing that a single olfactory neuron responds to several odorants and that each odorant is sensed by multiple olfactory neurons. On the similar lines of a human nose, electronic nose functions by using an array of sensors. The sensor array after sensing the aroma generates a pattern based on the type of smell. Further, the patterns obtained are trained to interpret and distinguish between various odours and odorants and to recognize new patterns [7]. A design and diagram comparing the fundamental analogies between human nasal sys tem (biological olfaction) and an electronic nose (artificial olfaction) low chart and is shown in Figure 2, Comparing the basic analogies **(a)** between biological olfaction, human nasal system and artificial olfaction; **(b)** block diagram of our prototype n-WSN with G-IoT supported electronic nose (e-Nose) as artificial senses.

### (b) Prototype Nanostructure Wireless Sensor Network System (n-WSN) as G-IoT applications

This techno-legal and socio-economical research has as main goal to evaluate the feasibility of a Next Generation Nanostructure Wireless Sensor Network System (n-WSN) as G-IoT application for forest fire and industrial emissions monitoring and protection in the smart world. Although there has been immense development of more sensitive and selective nano-structure sensor arrays and Artificial Intelligent (AI) enabling advanced data mining technology, there have been limited reports on the applications of electronic nose(eNose) for the measurement of industrial emis sions and forest fire protection. The current techno-legal research sheds light on the practical applicability of e-Nose for the effective industrial order and gaseous emissions measurement.

### (c) Environmental monitoringusing n-WSN Electronic Nose (e-Nose)

Electronic senses, namely electronic nose (e-Nose) and electronic tongue (e-Tongue), can be successfully used for monitoring environmental pollution. There is a need to develop devices capable of evaluating the state of the environment rapidly or even in real time, without supervision and at a relatively low cost. Electronic noses and tongues show promise in this regard and find application in monitoring the quality of water and of atmospheric air [7]. The analysis of atmospheric air can be performed in several ways. One can, for example, measure the concentration of several pre-defined substances or analyse the air holistically. Both these tasks can be performed using sensor systems. One of the first investigations in this area was performed in the first half of 1990' [8]. In it, a device equipped with CP sensors was used to analyse an aqueous solution of ethanol, diacetyl and dimethyl sulphide. Electronic nose was also used to measure the concentration of nitric oxide, methane

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and carbon monoxide at 500-2000 ppm concentrations. It is important to note, that when using e-Noses to determine particular substances there can occur interferences caused by the presence of other chemical compounds. A research has shown, that when determining hydrogen sulphide and nitrogen dioxide in a mixture containing carbon dioxide and water vapour the presence of humidity and $CO_2$ had a significant impact on the sensor's response signal, but it was possible to properly identify the components of the gaseous mixture using discriminant factor analysis [9]. It is possible to use the electronic nose to determine certain Volatile Organic Compounds (VOCs) at a very low concentration level (ppm level), even below the threshold limit value (TLV). That was the case with benzene, methanol, ethanol, toluene and acetone determined below TLV using a device equipped with Metal Oxide Semiconductor (MOS) sensors. Sensor drift poses a significant problem, leading to high measurement uncertainties. In most recent applications nWSN based G-IoT enable e-Noses are being mounted on mobile robots, but because of insufficiently advanced models of VOC and hazardous gas distribution this technology is yet to find real life applications. Another important application of e-Noses is odour classification and odour intensity evaluation. Currently, the golden standard in determination of odour nuisance is dynamic olfactometry [10].

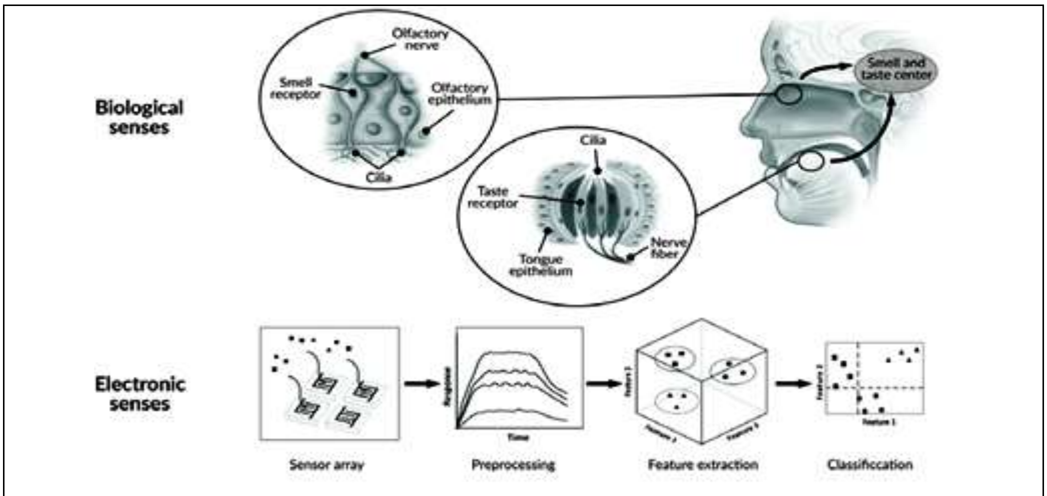


**Fig. 1. Comparing of the sense of smell and taste with artificial senses.**

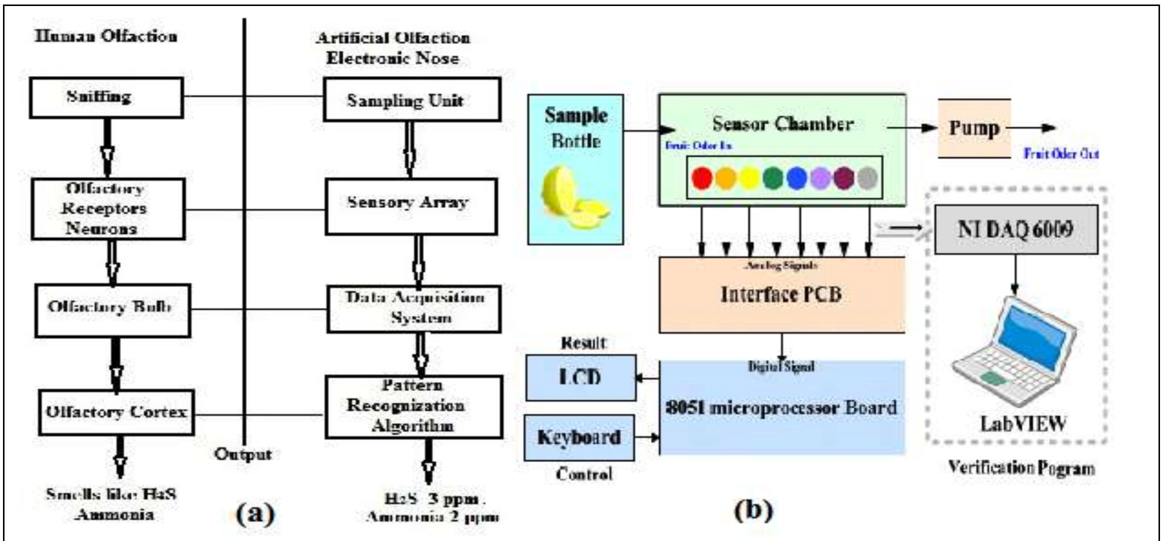


**Fig. 2 (a-b). Comparing the basic analogies (a) between biological olfaction, human nasal system and artificial olfaction; (b) block diagram of our prototype n-WSN electronic nose (e-Nose) as artificial senses.**

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**Fig. 3: A robust and remote controlled Silver doped Nanostructured Wireless Sensor Network (Ag doped nWSN) Butterfly-shaped Green IoT based for Concurrent Quantification of VOCs caused for Industrial emissions hazards and forest fire gaseous protection.**

**Table 1. Application of Nanostructured e-Noses in data analysis of VOCs caused for Industrial emissions hazards and forest fire gaseous protection.**

| Place and types of sample | Analysis process | Data analysis method [Ref.] |
|---|---|---|
| Air samples from composting plants, printing houses, sewage treatment plants, recycling plants, settlers | Water vapor, flammable gases, toxic gases, solvents | PCA, LDA |
| Samples of air from the sewage treatment plant and wetland cattle field and farmhouse | CO, $NO_2$, $CH_4$ ,VOC like (benzene, toluene, m-xylene) | PCA, FCM |
| Indoor air samples from duck and pigs farms | $H_2S$, $NO_2$, $SO_2$, $CH_4$ , VOC | KNN, SVM |
| Samples of indoor air from cars and internal air samples | CO, $NO_2$, ammonia, VOC like benzene, toluene, formaldehyde | PCA, PNN, SVM, KNN |

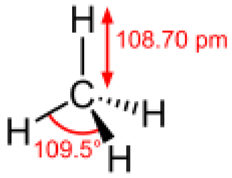
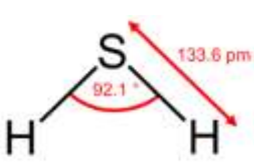
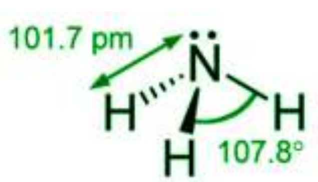
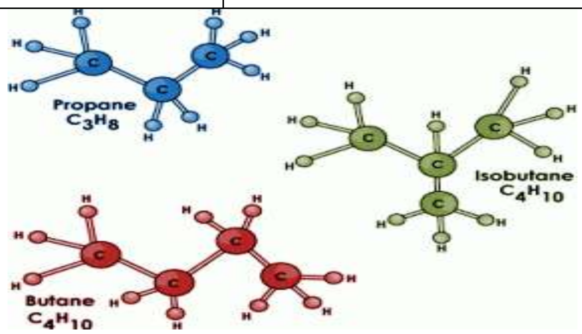
**(c) Data Analysis Methods**

The dataset obtained with the use of our prototype n-WSN electronic nose (e-Nose) as artificial senses contains the response signals of each sensor and usually is very complex. Analysis of this type of data is considerably more difficult, than in the case of a device equipped with only one sensor. For that reason the first step of data processing is usually meant to decrease the dimensionality of the dataset. Table 1**.** Application of Nanostructured e-Noses in analysis of VOCs caused for Industrial emissions hazards and forest fire gaseous**.** Doing this whilst retaining as much significant infor-mation as possible is one of key challenges in statistical data processing, as the results of data analysis should lead to reliable and repeatable results. Chemometric methods used for data pro-cessing utilize pattern recognition. Information contained in the sensor's response signal is compared with reference data. The basic steps of data analysis are as follows [11]:

• Pre-processing;
• Selection of variables;
• Classification;
• Decision making.

Preliminary analysis (pre-processing) is used to smoothen the signal, average sensor responses, and to filter the background noise [12]. Table 2: Chemical structure and properties of VOCs caused for Industrial emissions and forest fire gases. Nowadays, computer is well known device and available at every step. Perhaps the appropriate adaptation of artificial senses to the needs of the average user with researchers will launch a next generation in the field of our prototype n-WSN electronic nose (e-Nose) as artificial senses. Industrial Pollution, Biodiversity loss and Eco-logical disaster Protection using nWSN enabled G-IoT supported e-Nose in Smart World. Figure. 3: A robust and remote controlled Silver doped Nanostructured Wireless Sensor Network (Ag doped nWSN) Butterfly-shaped Green IoT based for Concurrent Quantification of VOCs caused for Industrial emissions hazards and forest fire gaseous protection [13].

Table 2: **Chemical structure and properties of VOCs caused for Industrial emissions and forest fire gases**

| | | | |
|---|---|---|---|
|   **(a) Methane** | |   **(b) Hydrogen sulfide** | |
| **Properties** | **Values** | **Properties** | **Values** |
| Molecular formula | $CH_4$ | Molecular formula | $H_2S$ |
| Molar mass | 16.043 g mol$^{-1}$ | Molar mass | 34.08 g mol$^{-1}$ |
| Density | 0.657 kg/L at 25°C | Density | 1.363 g/L |
| Boiling point | −161.50°C | Boiling point | −60 °C (−76 °F) |
| Solubility in water | Slightly soluble | Solubility in water | 4.0 g/l (at 20 °C) |
| Odour | Colourless, paraffin groups | Odour | Pungent, like that of rotten eggs |
|   **(c) Ammonia** | |   **(d) LPG = ( n-butane + iso-butane + propen)** | |
| **Properties** | **Values** | **Properties** | **Values** |
| Molecular formula | $NH_3$ | Molecular formula | $C_4H_{10}+C_3H_8+C_4H_{10}$ |
| Molar mass | 17.03 g mol$^{-1}$ | Molar mass | 44.1 g mol$^{-1}$ |
| Density | 0.86 kg/L at 25°C | Density | 2.009 kg/L at 15°C |
| Boiling point | 34.34 °C (14 °F ) | Boiling point | -42.25 °C to 42.04 °C |
| Solubility in water | Highly soluble | Solubility in water | Partially in hot water |
| Odour | Colourless, strong and pungent gas | Odour | Colourless, awfully flammable |

**(e) Procedures and Measurements**

Figure 4(a) shows block diagram of the prototyped nWSN with G-IoT enable n-Nose system, comprising a sensor array, an interface printed circuit board (PCB), and an microcontroller (µC) board embedded with a pattern recognition algorithm, as well as a verification program. Sensor responses pass through a data acquisition card (DAQ) to a laptop with a self-developed LabVIEW program for the purpose of verifying the function of the portable e-Nose system [14] .Figure 4(b) shows block diagram of the array consists of eight sensors, the Interface PCB includes eight interface processing Circuits (IPC),an eight to one multiplexer (MUX), and an 8-bit analog-to-digital converter (ADC). The eight interface processing circuits are connected to the eight sensors, which actively adapt the circuit to a preset baseline voltage. The multiplexer reduces the need for multiple ADCs by scanning the eight channels and choosing one channel at a time. The ADC converts sensor data into a digital form for data processing. Figure 4(b) shows a block diagram of the interface PCB and Figure 4(c) shows the basic architecture of

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the interface processing circuit (IPC), which operates in one of the two following modes:

## IV. EXPERIMENTATION

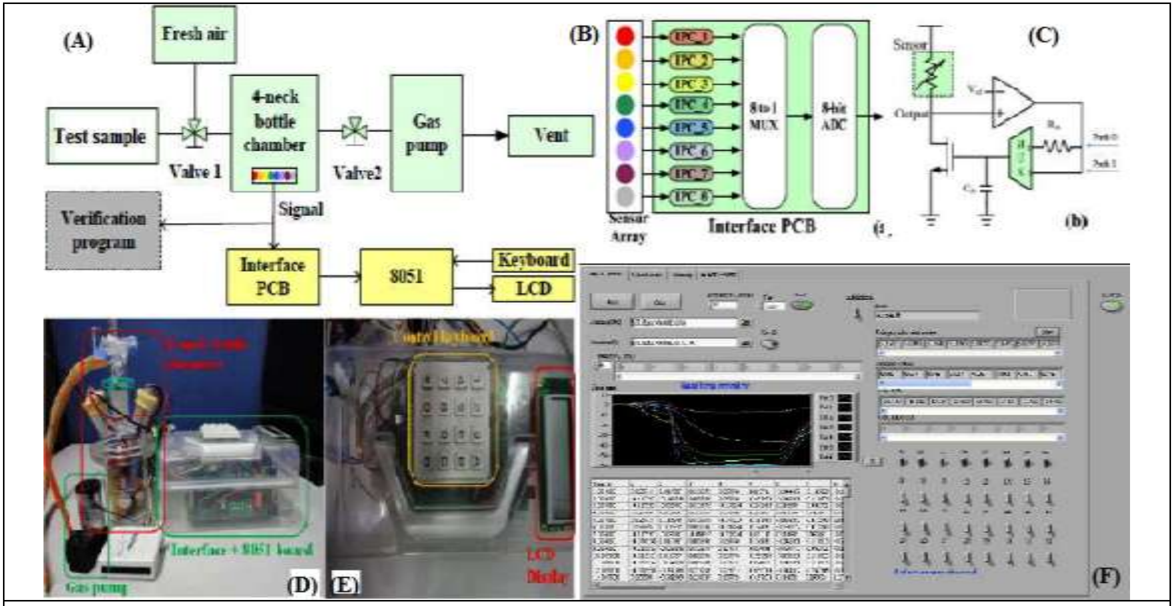


**Fig. 4 (A-E):** Experimental apparatus (A) Hazardous gas sensing setup for the prototype n-WSN with G-IoT enable E-Nose system; (B) Block diagram of the interface PCB; (C) Basic architecture of the IPC; (D) 4-neck bottle chamber, gas pump, interface circuit, and the G-IoT based microcontroller (μC) board; (E) Control keyboard and LCD display; (F) The data acquisition interface.

**(1) Adaptation mode:** in this mode, the circuit adjusts its operating point to a preset baseline voltage. The multiplexer chooses path "1" in Figure 4(c), to equalize the output voltage with the reference voltage Vref, which is set as the baseline value prior to sensing odours. In this mode, the NMOS transistor operates as a variable current source. At the end of the adaptation mode, the circuit enters the sensing mode, the gate voltage of the transistor becomes stable, and the transistor operates as a constant current source. After com-pleting the adaptation mode, the nWSN G-IoT enable e-Nose system is ready to accept input gas [15].

**(2) Sensing mode:** in this mode, the circuit is ready for sensing. The multiplexer chooses path "0" in Figure 4(c), to form a negative feedback loop, which establishes the sensor resistance of the n-WSN e-Nose. Due to a large time constant $R_a$ and $R_g$, the sensor resistance of the n-WSN e-Nose can be maintained a long enough time, comparing with the sensor response time. As a result, the IPC responds to the sensor while tuning out background signals; which is similar to the process performed like as biological noses. In this mode, variations in the sensor resistance are translated to a change in output voltage, which is fed into an ADC through an eight to one MUX, whereupon, the ADC output is send to the AI based G-IoT enabled n-WSN e-Noses are electrical resistance modulated sensing devices containing a sensor array capable of producing a digital fingerprint of volatile organic compounds released from any source [16].

The responses of the test hazardous gases have been calculated using the equation (1):

$$Response(R) = \left[\frac{(R_a - R_g)}{R_a}\right] \times 100\% \quad (1)$$

where, $R_a$ denotes the resistance in air and $R_g$ the resistance in the presence of a test gas. The response of the material is examined with VOC ($NH_3$, $H_2S$, $CH_4$, LPG) in the temperature range of 20–30°C, and the sensitivity and response have been observed to be quite appreciable.

The sensitivity and recovery of the test hazardous gases have been calculated using the equation (2):

$$Recovery\% = \frac{C_{Foundbycalibrationplot}}{C_{Added}} \times 100 \quad (2)$$

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## V. RESULTS AND DISCUSIONS

Users can read and classify odours through the classification interface, which implements six different data analysis methods algorithms, including nearest neighbor (NN), K-nearest neighbor (KNN), support vector machine (SVM), principle component analysis with nearest neighbor (PNN), principle component analysis with K-nearest neighbor (PKNN), and principle component analysis (PCA) with support vector machine (PSVM). Performing six different algorithms simultaneously enables the user to investigate and compare the efficiency and accuracy among each of the algorithms. The classification results, the "smell print", and PCA and LDA plots are also shown in Figure 6(a): on the interface. Environmental hazardous gases from industry emission gaseous sensing patterns of (a) Hydrogen Sulphide ($H_2S$), (b) Ammonia ($NH_3$), (c) LPG, and forest fire caused (d) Methane ($CH_4$) were used to test in the prototype nWSN based G-IoT enable n-Nose as artificial senses. The data regarding the gaseous odours was collected over a three-day span. On the first day, five different samples of each gaseous were collected. The average response of the five samples was used as the odour signature for that hazardous gaseous. Figure 5(a-d) shows the resulting patterns for testing the odour of the hazardous gaseous samples. The magnitude of each axis indicates the resistance change ratio (ΔR/R) in each sensor when reaching equilibrium.

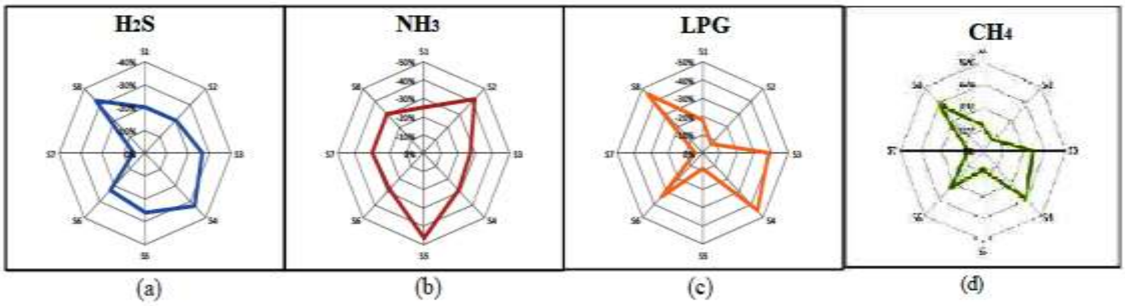


**Fig. 5 (a-d):** Shows the resulting patterns for testing the odour of the hazardous gaseous samples for (a) Hydrogen Sulphide ($H_2S$), (b) Ammonia ($NH_3$), (c) LPG, and forest fire caused (d) Methane ($CH_4$). The magnitude of each axis indicates the resistance change ratio (ΔR/R) in each sensor when reaching equilibrium.

Between the second day and the third day, two series of experiments were conducted. In the morning noon and evening time, five different places samples of each industry and forest were collected. For the duration of the experiment, the temperature was 20–30 ºC. Table 3: Summary of sensitivity and average accuracy is more than 93.10 percentage of classification results of the hazardous gaseous samples for (a) Hydrogen Sulphide ($H_2S$), (b)Ammonia($NH_3$), (c) LPG and (d) Methane ($CH_4$) for the six data analysis algorithms used in the verification software [17].

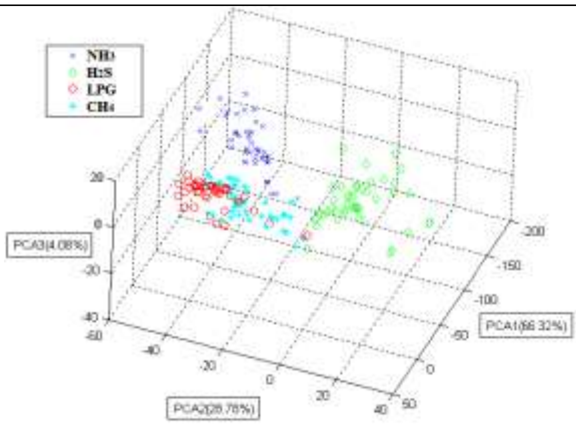


**Figure 6:** Shows a three-dimensional projection of the PCA results of all data analysis clustering points regarding the odour of hazardous VOC gaseous.

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**Table 3. Summarized Industrial hazardous gaseous sensing pattern of (a) Hydrogen Sulphide ($H_2S$), (b) Ammonia ($NH_3$), (c) LPG and (d) Methane($CH_4$). odour classification result for the six data analysis and clustering algorithms**

| VOC Gaseous | PCA | LDA | FCM | PNN | KNN | SVM |
|---|---|---|---|---|---|---|
| **$NH_3$** | 36/38 | 37/38 | 37/40 | 38/39 | 35/37 | 38/38 |
| **$H_2S$** | 33/38 | 33/38 | 36/38 | 37/40 | 36/40 | 35/40 |
| **LPG** | 34/36 | 36/40 | 36/38 | 34/36 | 34/36 | 33/36 |
| **$CH_4$** | 19/20 | 20/22 | 19/20 | 20/22 | 20/21 | 18/19 |
| **TOTAL** | 122/132 | 126/138 | 128/136 | 129/137 | 125/134 | 124/133 |
| **ACCURACY (%)** | **92.42** | **91.30** | **94.11** | **94.20** | **93.30** | **93.23** |
| **AVG. ACCURACY** | **93.10 (%)** | | | | | |

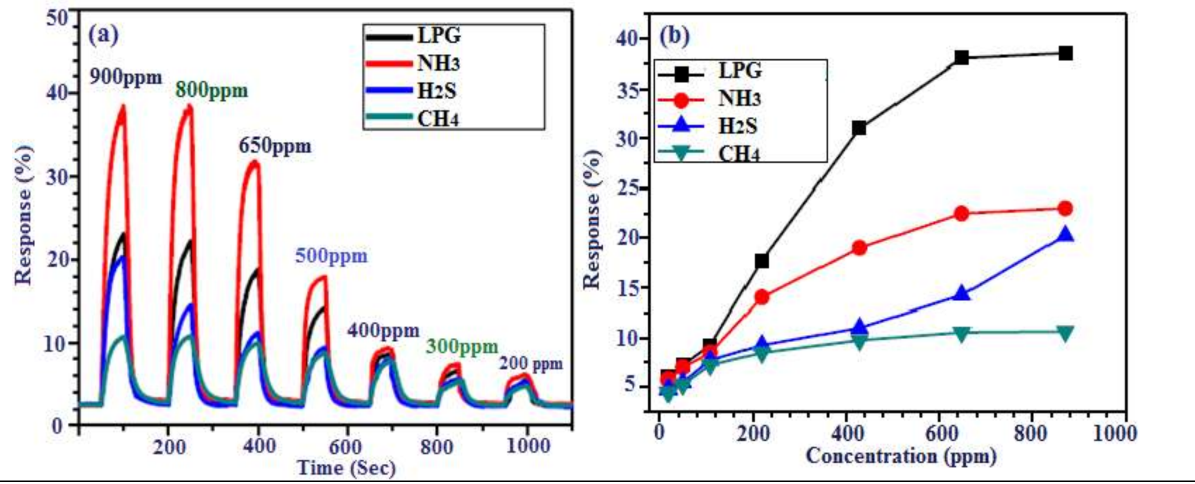


**Fig. 7 (a-b).** Response of n-WSN sensors as a function of time with **(a)** different concentrations and **(b)** response (%) of VOCs caused for Industrial emissions and forest fire gases.

## VI. CONCLUSION AND FUTURE ENDEAVORS

We have developed a prototype of a portable electronic nose (e-Nose) comprising an interface PCB and a digital microprocessor board. We also developed and tested KNN classification algorithms. A parallel verification program was developed to verify the functions and the algorithms of the system. The prototype has been tested with three complex industrial emission gaseous odors, namely, (a) Hydrogen Sulphide ($H_2S$), (b) Ammonia ($NH_3$), and (c) LPG and Methane ($CH_4$) also known as natural gas for protection of unwanted forest fire and ecological disaster. The prototype of the proposed portable n-WSN E-Nose system and the verification software achieved a classification accuracy in excess of 95%. This E-Nose prototype **Nanostructure Wireless Sensor Network System (n-WSN) as G-IoT e-Nose applications** is highly suitable for implementation as a portable system. G-IoT supported e-Noses are electrical resistance modulated sensing devices containing a sensor array capable of producing a digital fingerprint of volatile organic compounds released from any source. Conductive polymer sensor array take advantage of differential responses of different conducing plastics (within each sensor) to various chemical species in the sample headspace by producing a unique electronic aroma signature pattern (EASP) specific to the analyte mixture [18]. The response of each sensor is based on the collective effect of the entire mixture of components in the headspace on electrical resistance changes generated by adsorption of analyte to the sensor. New developments include integrated systems the use of molecular beacons and nanosensor production. These should ensure even more rapid and specific detection. The potential development of this technology coupled with remote data acquisition and central processing powered by hybrid artificial intelligence systems could make this appreciate world-wide [19].

## VII. ADVANAGES FROM THE ABOVE RESULTS

**Human rights, forest wildlife and biodiversity:**

In human rights 3.0, the "gushers" of data and unprecedented computing power for processing it have made it possible for engineers to create artificial intelligence based on "deep learning" that is, digital neural networks in which computers can learn from data the way that babies learn from the environment around them, starting with little knowledge and then acquiring proficiency and familiarity as they interact with new environments [20]. Deep learning, machine learning, and other disruptive technologies of automated data processing pose different kinds of risks to rights-based societies, often through initiatives intended to make justice more efficient. Software engineers, with their inclinations toward appropriate vulgarity, commonly refer to this problem as "shit in, shit out." In AI circles and in the literature, it is also referred to as "garbage in, garbage out."

**Early Warning (EW) and Risk Assessment:**

United Nations Environment Programme catalogues **wildfires** - and therefore, forest fires - as on-going and rapid/sudden-onset environmental threats (UNEP, 2012). Forest fires create a hazard to lives and properties and are often connected to secondary effects such as landslides, erosion, and changes in water quality [21]; therefore, the UNEP considers that **early warning systems** are of great importance for preventing or limiting environmental and economical damages. **Early Warning (EW)** is defined as "the provision of timely and effective information, through identified institutions, that allows individuals exposed to hazard to take action to avoid or reduce their risk and prepare for effective response" (UN, 2006), and it implies the combination of four main elements according to the United Nations' International Strategy for Disaster Reduction – (ISDR): (i) **Risk Knowledge and Risk Assessment, (ii) Monitoring and Predicting -** in order to provide appropriate estimates of the potential risk encountered by communities, economies and the environment, (iii) **Disseminating Information** - through electronic communication systems in form of reliable, synthetic and simple warning messages. (iv) **Response** - according to appropriate action plans. Nevertheless, extant research on EW emphasizes, predictions are not useful, however, unless they are translated into a warning and action plan the public can understand and unless the information reaches the public in a timely manner. When monitoring and predicting systems are associated with communication systems and response plans, they are considered early warning systems (Glantz, 2003).

**India's Biodiversity Act**, 2002 envisages the establishment of a National Biodiversity Authority for discharging the statutory powers provided for under the legislation. The chief concerns of the 1992 Convention on Biological Diversity are conservation of biological diversity, sustainable utilization of its components and equitable sharing of benefits. Thus, the last two and half decades has seen two important international instruments such as the 1992 Convention on Biological Diversity and the 1993 Agreement on Trade Related Intellectual Property Rights (TRIPS Agreement) as a part of World Trade Organization (WTO) and are in force. Most of the TRIPS Agreement members are parties to the 1992 Convention. India is the party to both of these instruments [21]. There are many interrelated provisions and diametrically opposite rights and obligations under these instruments. The two main overlapping areas in these Conventions are protection and access to biological and genetic resources. According to the Article 27(1) provides that patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application. However, members may also exclude from patentability of diagnostic, therapeutic and surgical methods for the treatment of humans or animals, plants and animals other than micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, members shall provide for the protection of plant varieties either by patents or by an effective sui generis system or by any combination thereof. Thus, the Article 27(2) provides thus: "Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is necessary to protect ordre public or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by their law". In fact [23], Article 8(j) of the 1993 TRIPS Agreement authorizes its members, in formulating or amending their national laws and regulations to "adopt measures necessary to protect public health and nutrition, and to promote the public interest in sectors of vital importance to their socio-economic and technological developments"., provided such measures are consistent with other 1993 TRIPS Agreement provisions [22,24].

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