JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

AI Nose For Identify Covid-19

[1]Prabha R, [2]Arun P, [3]Vetrivel S, [4]Priyadharshan A.A, [5]Vishwa Prabagar T

[1]Associate Professor, [2]Student, [3]Student, [4]Student, [5]Student
[1]Department of Electronics and Communication Engineering,
SNS College of Technology, Coimbatore, Tamil Nadu, India

Abstract : Electronic/Artificial noses have provided external benefits to a variety of commercial industries. Agriculture, biomedical, cosmetics, environmental, food, water, and various scientific research fields. The electronic nose detects hazardous or poisonous gas in ways that human sniffers cannot. Smells are made up of molecules that have a specific size and shape. Each of these molecules has a receptor in the human nose that is the right size and shape for it. When a molecule is detected by a specific receptor, it sends a signal to the brain. And the brain identifies the smell associated with that particular molecule. The electronic noses Work similarly to humans. Sensors serve as the receptor in the electronic nose. When A specific sensor receives the molecules; it transmits the signal to a program for processing rather than to the brain.

***IndexTerms* – Electronic nose,covid,odour,voc gas.**

I INTRODUCTION

The last year has been critical for the whole world. The unexpected COVID-19 the pandemic completely changed the daily life of most of the population. In our day-to-day life we are talking about the number of confirmed cases, death rates, hospitalizations, and discussions are constantly being held on how to improve the testing efficiency for COVID-19, to better understand and contain the disease's spread.

The World Health Organization (WHO) has declared the coronavirus disease 2019 (COVID-19) a pandemic. A global coordinated effort is much needed to stop the further spread of COVID -19. A wide geographic area affected by an exceptionally high proportion of the population is defined as a pandemic, and the H1N1 Flu Pandemic was the last reported pandemic across the world.

The World Health Organization reported a cluster of cases of pneumonia of unknown cause, in the City of Wuhan, Hubei province in China on December 31st of 2019. In January 2020, a previously unknown new virus was identified, subsequently named the 2019 novel coronavirus, and samples obtained from cases and analysis of the virus' genetics indicated that this was the cause of the outbreak. This novel coronavirus was named Coronavirus Disease 2019 (COVID-19) by the WHO in February 2020. The virus is referred to as SARS-CoV-2 and the associated disease is COVID-19.

1.1WHAT IS AI NOSE

AI nose technology may have the potential to substantially slow the spread of contagious diseases with rapid signal indication. As our understanding of infectious diseases such as Corona Virus Disease 2019 improves, we expect AI nose technology to detect changes associated with the pathogenesis of the disease such as biomarkers of immune response for respiratory symptoms, central nervous system injury, and/or peripheral nervous system injury in an individual's breath and/or odour. A design of an electronic nose was created in this paper to detect the concentration of alcohol, acetone, and carbon monoxide in a COVID-19 breath simulation sample. The four most prominent volatile compounds in COVID-19 patients were methylpent-2- enal, 2,4-octadiene 1-chloroheptane, and nonanal.

II EXISTING SYSTEM

2.1 MOLECULAR (RT-PCR) TESTS

About the test- The RT-PCR test, is a method of testing that is used to directly detect the presence of the virus in the sample. The test detects the virus's RNA, which is the genetic material of the virus. The first step on this check is to transform this RNA to DNA the use of an enzyme called the opposite transcriptase.. The PCR checking out then detects this DNA so they called RT-PCR. These are also called the diagnostic test and nucleic acid amplification test (NAAT).
How the sample is taken- A nasal or throat swab pattern is taken.
Time taken to get results- Results are given the equal day or inside 2-3 days.
Are they accurate- These assessments are the maximum accurate? They have a excessive sensitivity and specificity.
What it shows- These tests make the diagnosis of active coronavirus infection. If the virus is present in the sample, the test is positive but a negative test does not necessarily mean you are not infected, you may have taken the test early on.
What it can't show- It does not show if you have ever had COVID-19 in the past.

Cost of RT-PCR test- Cost of the antibody test package is someplace among Rs 2000- Rs 3000.
In case you experience you've got signs of COVID-19, you can approach your doctor who can further advise you for a test.

2.2 COVID-19 ANTIGEN TESTS

About the test- A COVID-19 antigen refers to any foreign matter or viral proteins in the body that triggers an immune response. This test helps in the identification of antigens associated with the COVID-19 virus. The antigen test, also known as the rapid antigen test, is a type of rapid diagnostic test that produces results faster than molecular tests. But there is a drawback, antigen tests have a higher chance of missing an active infection.
How the sample is taken- Usually, nasal or throat swab sample is taken.
Time to get results- Because it is a rapid test, results are delivered in one hour or less.
Is another test needed– Rapid tests are usually highly accurate if you test positive, but a negative result may need to be confirmed using a molecular test.
What it shows- These tests help in the identification of active coronaviruses in samples.
What it cannot show- In comparison to RT-PCR tests, the antigen test may miss an active coronavirus infection.
Cost of COVID-19 Antigen test- The COVID-19 antigen test kit costs in the range of Rs 400 to Rs 500

2.3 COVID-19 ANTIBODY TESTS

About the test– In addition, serologic tests, serology, or blood serology known as the COVID19 antibody test is based on a screening test for your COVID19 antibodies in the blood. It indicates if you have previously been infected with the virus that causes COVID 19. The antibody test does not look for the active virus but checks whether your immune system has responded to the infection.
How the sample is taken- It is tested by taking your blood sample.
Time taken to get results- Results are delivered either the same day or in 1-3 days.
Is another test needed- A second COVID-19 antibody test may be required for more accurate results.
What it shows- This test determines whether you were previously infected with the virus that causes COVID-19 and now have antibodies against it.
What it cannot show- A COVID-19 antibody test may not detect an active virus in your body that is causing COVID-19 infection.
Cost of Antibody test- The COVID-19 antibody test kit costs in the range of Rs 500 to Rs 600.

2.4 Drawback of Existing System

1. Long turnaround times – While RT-PCR tests can produce results on the same day or within one to two days in some cases, test results as long as one to two weeks have been reported during the pandemic.
2. False negatives – molecular tests have been shown to produce results that indicate the patient does not have the virus when they do; false-positive rates have ranged from 2% to 37%.
3. Uncomfortable for some people – deep nasal swabs can be uncomfortable for some people, especially small children.
4. Performed at a hospital or clinic: Home antigen testing is not widely available, so patients usually need to go to a hospital or clinic to perform this test.
5. High false-negative rate: Antigen tests produce higher false-negative rates than molecular RT-PCR tests, with some evidence suggesting rates as high as 50%.
6. Can take a few days to get results.

III PROPOSED SYSTEM

3.1 INTRODUCTION

This project proposed a method to classify Covid 19 Breath Exhaled Gas odor by using e-Nose combined with machine learning methods. The proposed system is classified into two models there are **GAS DETECTOR MODEL** and **SVM CLASSIFIER MODEL.**

3.2 E-NOSE COVD19 EXHALED GAS DETECTOR MODEL

Methods applied in many areas: environment, factory, and medical. E-Nose consists of a sensor array, controller, and artificial intelligence. Sensor arrays are built from gas sensors such as conductive polymers (CP), metal oxide semiconductor (MOS), metal oxide semiconductor field-effect transistors (MOSFET), and Quartz crystal microbalance (QCM). The exhaled breath was captured by gas sensors, which are MQ-2 MQ-135, MQ-138, and MQ-137. Those sensors are formed to detect VOC gas from exhaled breath—the exhaled breath data is processed by signal processing methods, data filtering, and normalizing. The final stage is data modeling with regression and dataset creation. The four most prominent volatile compounds in COVID-19 patients were methylpent-2-enal, 2,4-octadiene 1-chloroheptane, and nonanal.

3.3 E-NOSE SVM CLASSIFIER MODEL

SVM is a classification algorithm that finds a flat classification boundary between two-class data sets. The concentration distribution of selected VOCs is wide and the boundary between cancer and healthy samples is unclear. As a result, using linear SVM to classify VOC samples is difficult. We introduced a nonlinear SVM with a Gaussian kernel function, which is widely used for classifying biological data. In general, The coordinates of the data points are transformed to a higher dimensional coordinate space, where SVM can draw a straight line between the transformed two-class data set. The kernel function defines the coordinate transformation. We used a Gaussian kernel function, $\exp(-\|x1-x2\|2/2\sigma2)$, where x1 and x2 are normalized VOC data points and is a σ scaling parameter for the distance between the points. Another parameter, C, controls the misclassification penalty. Here, set $\sigma = 1.5$ and C=1000 to reduce the number of data points used to determine the classification boundary (support vectors), so that SVM does not overfit the dataset. Schematic of a nonlinear support vector machine (SVM). (a) The two-class data set is made up of two VOCs (VOC 1 and VOC 2; left panel) that are transformed into a different coordinate space (right panel) where the dataset can be classified by a flat boundary; (b) The SVM boundary (thick line) is determined using data points known as support vectors. To avoid overfitting the data points, the number of support vectors should be kept to a minimum.

3.4 BLOCK DIAGRAM

The electronic nose has a housing retaining an array of metal-oxide-semiconductor (MOS) gas sensors retained in the chamber of the housing. These sensors are capable of being saturated by a target gas to then produce a voltage drop across the sensors resulting in an output response in volts (V). The MOS-based sensors are capable of detecting gas concentrations in parts-per-million (ppm) of CO, acetone, and alcohol. Referring to Figure 3.1, the circuitry of the first Arduino Uno microcontroller electrically connects to the MOS-based MQ-2, MQ-135, MQ-137, and MQ-135 gas sensors. The microcontrollers are electrically wired to a 5V power source being an electronic device such as a computer. The electronic device has a graphic user interface configured for a programmer to calibrate the gas sensors, define threshold values, and collect data about the detected gas identity.
To create an e-Nose system, some devices are used the end device (ESP8266, Atmega GAS Sensors), Access point, and server. In the server, some activities were performed to process the exhaled breath data. Exhaled breath was recorded and saved to the database on the server.

After the gases emitted by the simulated breath sample solution saturate the sensors within the electronic nose's internal bladder, the analog signal from the MQ-2, MQ-137, MQ-138, and MQ-135 sensors are transmitted to an LM393 High Precision Comparator configured to digitize the signal. The comparator determines when the threshold values set by the potentiometer of the sensors have been met. Within approximately 27 seconds of the initial sample introduction, the sensors of the electronic nose interface with a microcontroller Arduino Uno, and the sensor values of CO, alcohol, and acetone concentrations are displayed on the monitor. The Arduino Uno code converts the digital signal from output response (V) into concentration (ppm) based on the resistance ratio (RS/R0) of the resistance change when the sensor is exposed to a target gas (RS) with the stable sensor resistance of the sensor in clean air (R0). Thus, a detected target gas of a sample may be detected and measured to indicate the approximate concentration in ppm.

In a multi-level analysis, we discovered a distinct COVID-19 breath print. We were able to distinguish between COVID-19 and non-COVID-19 ARDS with a 93% accuracy (sensitivity: 90%, specificity: 94%, area under the receiver operating characteristic curve: 0-94-0-98). The four most prominent volatile compounds in COVID-19 patients were methylpent-2-enal, 2,4-octadiene 1-chloroheptane, and nonanal. The server's data analysis was done through some pre-processing stages and sensor modeling, training, and classifying. Covid 19 and Non-Covid 19 breathe normally and blow the air into the airbag. The exhaled breath gets through the end device after the airbag is fully contained with air. It constantly flows to the end device every time the subject breathes. The airbag is one time used for every subject to avoid the interference of exhaled breath from the previous measurement.

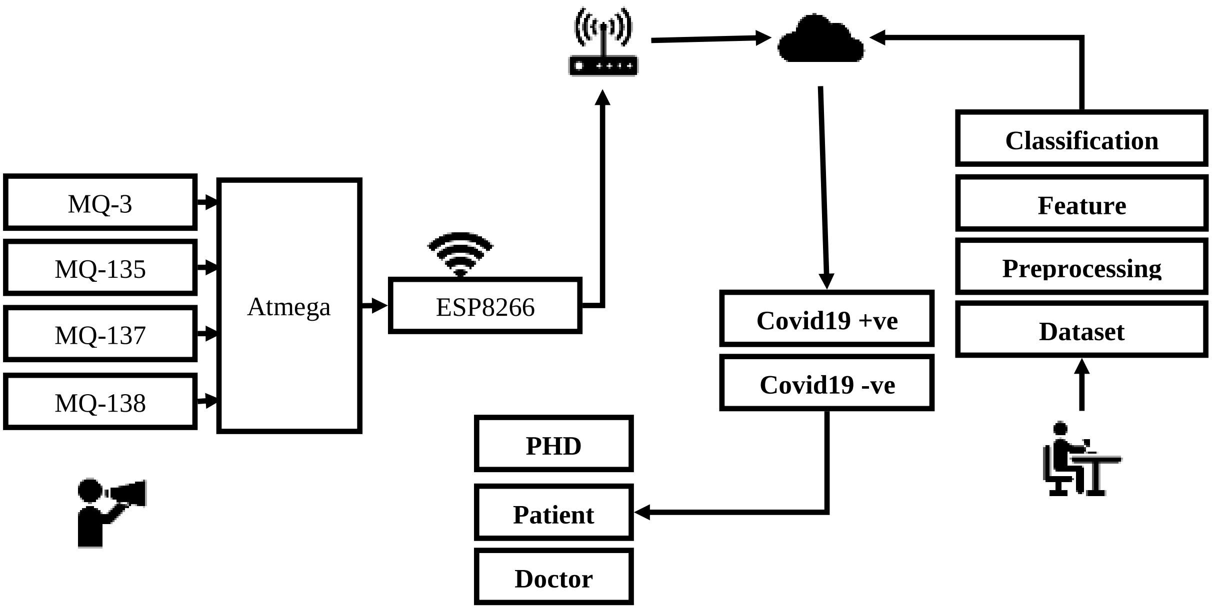

Fig.3.1. Block Diagram of Proposed System

3.5 Arduino Uno

Figure 3.2 shows the view from above. The ATmega328P-based Arduino Uno is a microcontroller board. There are 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analog inputs, a 16MHz crystal, a USB port, a power jack, an ICSP header, reset button. It includes everything required to support a microcontroller. Connect it to your computer with a USB cable or turn it on with an AC to DC adapter. Arduino Uno has several facilities for communicating with a computer, another Arduino board, or other.

Fig.3.2. Arduino Uno

3.6 ESP8266 wi-fi Module

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by the Espressif system. It is primarily used to create IoT (Internet of Things) embedded applications. It runs at 80 MHz on a 32-bit RISC CPU based on the Tensilica Xtensa L106 (or overclocked to 160 MHz). It has a 64 KB boot ROM, 64 KB instruction RAM, and 96 KB data RAM. SPI can be used to access external flash memory. The ESP8266 module is a low-cost standalone wireless transceiver that can be used for end-point IoT developments. The microcontroller must use a set of AT commands to communicate with the ESP8266 module. The microcontroller communicates with the ESP8266-01 module using UART having a specified Baud rate. Many third-party manufacturers produce different modules based on this chip.

Fig.3.3. ESP8266-01 Wi-Fi Module

3.7 MQ-2 Sensors to detect gas

It is very simple to detect a gas using a MQ sensor. You can accomplish this by using either the digital or analogue pins. Simply connect the module to 5V and you should see the power LED on the module glow. If no gas is detected, the output LED will remain turned off, indicating that the digital output pin is set to 0V. Remember that these sensors must be pre-heated (as mentioned in the features above) before you can work with them. Introduce the sensor to the gas to be detected, and the output LED and digital pin should light up; if not, adjust the potentiometer until the output lights up. Now, whenever your sensor is exposed to this gas at this concentration, the digital pin will either go high (5V) or remain low (0V). The analogue pin can also be used to accomplish the same thing. Using a microcontroller, read the analogue values (0-5V), which will be directly proportional to the concentration of the gas detected by the sensor. You can experiment with these values to see how the sensor reacts to different gas concentrations and then adapt your program accordingly.

Fig.3.4. MQ2 Gas sensor

3.8 MQ-135 Gas sensor

The MQ-135 Gas sensors are used in air quality control equipment and are suitable for detecting or measuring NH3, NOx, Alcohol, Benzene, Smoke, and CO2. The MQ-135 sensor module includes a Digital Pin, which allows this sensor to operate without a microcontroller, This is useful when only attempting to detect a single gas. If you need to measure the gases in PPM the analogy pin needs to be used. The analogy pin is TTL driven and works on 5V and so can be used with the most common microcontrollers. If you need a sensor to detect or measure common air quality gases like CO2, smoke, NH3, NOx, alcohol, or benzene, this is the sensor for you.

Fig.3.5. MQ-135 Gas Sensor/Module

3.9 MQ-137 Gas sensor

The MQ-137 is a gas sensor that detects ammonia (NH3). The sensing element is SnO2, which has a lower conductivity in clean air. When NH3 (Ammonia) gas is present, the sensor's conductivity increases as the gas concentration increases. A simple circuit makes measuring the change in conductivity and converting it to data relatively simple, but it does necessitate some calibration.

. Fig.3.6. MQ-137 - Ammonia Gas Sensor

3.10 MQ-137 Ammonia Gas sensor

The MQ138 gas sensor is extremely sensitive to Toluene, Acetone, Ethanol, and Formaldehyde, as well as other organic steam. The sensor could be used to detect various organic steams; it is inexpensive and suitable for a variety of applications.

Fig.3.7. MQ-138 gas sensor

IV RESULTS AND DISCUSSION

4.1 INTRODUCTION

The exhaled breath device figure 4.1 shown below was captured by gas sensors, which are MQ-2 MQ-135, MQ-138, and MQ-137. Those sensors are formed to detect VOC gas from exhaled breath—the exhaled breath data is processed by signal processing methods, data filtering, and normalizing. The final stage is data modeling with regression and dataset creation. The four most prominent volatile compounds in COVID-19 patients were methylpent-2-enal, 2,4-octadiene 1-chloroheptane, and nonanal.

Fig.4.1. Artificial Intelligence Nose

The patient detail are collected and stored in data base for future reference the database sample image is shown below fig 4.2.

Sno	Name	Gender	Age	Mobile No.	E-mail	Address	City	Action
1	Krishna	Male	43	9843382038	guru@gmail.com	33,SS Nagar	Trichy	Test / Delete
2	Sathish	Male	23	9856470436	sathish@gmail.com	2/654, GS Colony	Salem	Test / Delete
3	Vinay	Male	36	9067674532	suresh@gmail.com	22,DR Nagar	Thiruvarur	Test / Delete

Fig.4.2. AI Nose Database

V CONCLUSION & FUTURE DEVELOPMENT:

5.1 CONCLUSION

The recent COVID-19 pandemic has presented the world with significant challenges in rapid diagnostics and outbreak monitoring. Selective sensing approaches that rely on specific and well-defined targets, such as in PCR, have been adopted for fast diagnostics, but substantial pitfalls still exist. Indeed, such detection techniques are highly disease-specific, and their adaptation in the case of SARS-CoV-2 mutations necessitates a significant amount of effort and time. On the other hand, a nonspecific sensing approach, primarily based on breath samples, could go a long way toward promoting healthy, responsible self-care. The e-Nose system was successfully designed and implemented to classify the exhaled breath. The method accuracies were 92% Support Vector Machine—94.87%.

5.2 FUTURE DEVELOPMENT

In the future, E-Nose can be used as a platform for other medical conditions other than achieving its original goal of monitoring astronaut health and cabin air quality.

REFERENCES

[1] Juan Guo; Yu Cheng; Dehan Luo; Kin-Yeung Wong; Kevin Hung; Xin Li, "A deep learning framework for odor descriptor rating prediction using Electronic nose" IEEE Sensors Journal (Volume: 21, Issue: 13, July 2021).

[2] Hendrick Hendrick; Rahmat Hidayat; Gwo-Jiun Horng; Zhi-Hao Wang, "Non-Invasive Method for Tuberculosis Exhaled Breath Classification Using Electronic Nose" IEEE Sensors Journal (Volume: 21, Issue: 9, May 2021).

[3] Ryan Joseph Ward; Fred Paul Mark Jjunju; Elias J. Griffith; Sophie M. Wuerger; Alan Marshall "Artificial Odour-Vision Syneasthesia via Olfactory Sensory Argumentation" IEEE Sensors Journal (Volume: 21, Issue: 5, March 2021).

[4] Junhui Qian; Yu Luo; Fengchun Tian; Ran Liu; Taicong Yang "Design of Multisensor Electronic Nose Based on Conformal Sensor Chamber" IEEE Transactions on Industrial Electronics (Volume: 68, Issue: 7, July 2021).

[5] Riyanarto Sarno; Kuwat Triyana; Shoffi Izza Sabilla; Dedy Rahman Wijaya; Dwi Sunaryono; Chastine Fatichah "Detecting Pork Adulteration in Beef for Halal Authentication Using an Optimized Electronic Nose System" IEEE Access (Volume: 8) December 2020.

[6] Jacob Laurence Newman; John Phillips; Stephen Cox "1D Convolutional Neural Networks for Detecting Nystagmus" IEEE Journal of Biomedical and Health Informatics (Volume: 25, Issue: 5, May 2021).

[7] Yutong Tian; Jia Yan; Yiyun Zhang; Tianhang Yu; Peiyuan Wang; Debo Shi; Shukai Duan "A Drift-Compensating Novel Deep Belief Classification Network to Improve Gas Recognition of Electronic Noses"IEEE Access (Volume: 8) 02 July 2020.

[8] M. Abdelkhalek; S. Alfayad; F. Benouezdou; M. B. Fayek; L. Chassagne "Compact and Embedded Electronic Nose for Volatile and Non-Volatile Odor Classification for Robot Applications" IEEE Access (Volume: 7) July 2019.