DETECTION OF EXHALE ANALYSIS THROUGH ARDUINO AND INTEGRATED SENSORS

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Abstract:

Nowadays population growth increasing exponentially and also health diseases increase parallel due to environment and manmade things. A common person live healthy to required things are air, food, water environmental conditions and our body functioning. Due to these above parameters health issues are affecting and medical Diagnosis is too costly. The proposed analysis is helping out to every common people with their exhale; through their exhale they can analyze present environmental and body circumstances. The basic analysis is exhale air quality index comparing some gases like carbon oxide, nitrogen, argon and oxygen. The detection of exhale and analysis forms a major application in therapeutic field. It helps in detecting the deviation real time by using Arduino and integrated sensors. The developed system systematically monitors the gases Parameters to get down various consequences so that early detection of dieses symptoms is possible. Detection of abnormality may lead to avoidance of chronic respiratory diseases.

Keywords: Exhale, Arduino, integrated sensors, gases and detection of abnormality

1. Introduction

Inhalation forms one of the fundamental and essential factors for the continued existence of all the living beings. “Breathing is the mixture of primarily nitrogen, oxygen, carbon-dioxide, water vapor & inert gases and outline amounts - parts per million by volume to parts per trillion of volatile organic compounds [1]. Inhalation and exhalation take place straight away one after the in a succession. The breathing rate in the subject to the activity he/she is into. For example, the breathing rate of the physical activity like walking, functioning or calisthenics is different when he/she is asleep. Breathing is slightly lowers when the issue is inactive or in sleep, [2, 3]. Breathing is acts as a physiological pointer and is used as a critical compute of the subject’s psycho-physiological state, [4, 5]. Breath detection on the whole involves capturing of breaths from the subjects using different circuits and processing the data obtained from these devices.
The smart Healthcare Monitoring System Using Raspberry Pi on internet of things Platform, the system receives the information from the sensors, and integrated these with the board. Raspberry Pi is the major tool in the proposed system; it is connected to all other sensors [6]. Arduino Uno is an ATmega328 compatible microcontroller board It has fourteen input/output pins, half a dozen analogue inputs, sixteen Mega Hertz frequency silicon oscillator, USB associate, influence socket, ICSP header associated and push button switch to reset[[7,8]]. Just connect this to your notebook using USB cable or connect it to the associated battery or AC-DC adapter to start the process.

2. Mathematical analysis of Exhale Temperature

The human body temperature is vital role to play the person healthy or unhealthy. The decision factor is temperature; the normal human body temperature is 96-98 f. once the normal temperature is increase, then the person is suffering some sick. Its may fever or other organs are affected, so body in abnormal conditions.

These abnormal conditions are anglicizing through the ideal gas constant equation, the ideal gas constant equation is derived into temperature equation, and the temperature equation is detect the person temperature the equation shown below.

$$PV = NKT \qquad 1$$

$$T = \frac{PV}{\log(NK)} \qquad 2$$

The pressure of one atmospheric of 760 mm H_g, pressure volume (pv) is exhale, K is bolts men constant is exhale temperature and N is number of mixer gases. The above equation 2 is simulating in mat lab, the gases density factorial factor is deciding the exhale temperature levels.

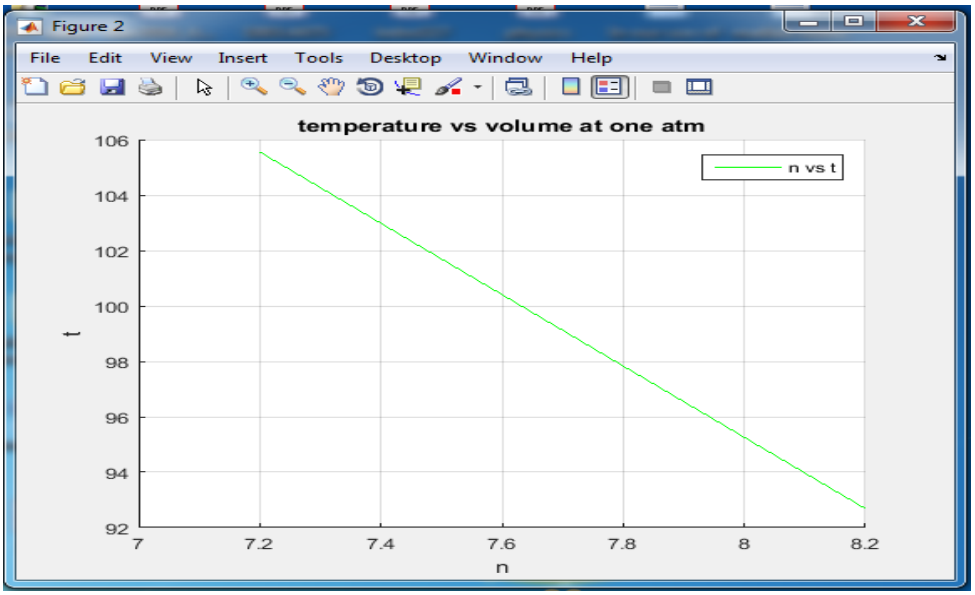

Figure.1. exhale temperature

The figure 1 is shown above exhale temperature, simulated in Matlab, the corresponding mathematical formula can give above results, the key factor is gases density factorial factor is deciding the exhale temperature levels. The person is can able to test their own at any time and any place the environmental and person functioning like normal and abnormal conditions of exhale temperature normal and abnormal.

3. Mathematical analysis of Exhale gases

The environmental air is a mixture of gases, which contains of Nitrogen (78.08%), oxygen (20.95 %), carbon dioxide (0.04) the inert gas like argon (0.9%), neon, helium, krypton and xenon (0.01%). The remaining gases (0.02 %).

The gas exchange and transport in circulatory system, the oxygen (O_2) and carbon dioxide (CO_2) exchange between pulmonary capillaries and lungs and between systemic capillaries and tissues, along with (O_2) and (CO_2) transport by blood throughout the circulatory system. The partial pressures of the O_2, PO_2 and CO_2 ,PCO_2 content in the lung are important for the gas exchange between alveoli and blood vessels. This can be derived from Dalton's law [9] that the total pressure in a gas is equal to the sum of its partial pressures:

$$P_{EX} = \sum_i P_i = P_{O_2} + P_{N_2} + P_{CO_2} + P_{ar} + P_{inert\ gas} + P_{H_{2_o}} \quad 3$$

And that the partial pressure is equal to the total pressure times the fraction of the volume.

$$F_i = \frac{V_i}{V_{total}} \quad 4$$

This yields for the gas pressure in the lung

$$P_{lung} = P_{O_2} + P_{N_2} + P_{CO_2} + P_{ar} + P_{inert\ gas} + P_{H_{2_o}} \quad 5$$

To calculate the oxygen and carbon dioxide fractions in the alveoli, the balance between the inhaled, the absorbed, and the exhaled oxygen amount has to be determined. With an inhaled oxygen flow of

$$f_{i_{O_2}} * F_{Total} \quad 6$$

($f_{i_{O_2}}$ is oxygen fraction in inhaled air,F_{Total} is total gas ventilation rate)

An exhaled amount of

$$f_{av0_2} * F_{tot} \quad 7$$

($f_{avo_2} is\ oxygen\ fraction\ in\ alveoli$)

The rate of oxygen absorption by the alveoli, Fo_2 is

$$F_{O_2} = f_{i_{O_2}} * F_{total} - f_{avo_2} * F_{total} \quad 8$$

The rate of carbon dioxide extraction from the blood, F_{CO_2} is

$$F_{CO_2} = f_{avo_2} * F_{total} \quad 9$$

This yields for the oxygen and carbon dioxide fractions in the alveoli

$$f_{avo_2} = f_{io_2} - \frac{F_{CO_2}}{F_{total}} \quad 10$$

$$f_{avco_2} = \frac{F_{CO_2}}{F_{total}} \quad 11$$

Here some typical values are taken from[9] $F_{O_2} = 0.28\frac{l}{min}$, $F_{CO_2} = \frac{0.23l}{min}$,F_{total} =4.1 l/min and the atmospherically fraction on oxygen $f_{i_{O_2}} = 0.21$ P_{atm} is 760 mm H_g,$P_{H_{2o}}$ is 47 mm H_g, $P_{I_{o2}}$ is 150 mm H_g ,standard values for the oxygen and carbon dioxide fractions in the alveoli can be obtained: $f_{avo_2} = 0.14$ $f_{avco_2} = 0.056$

This results in partial pressures using Dalton's law:

$$P_{avo_2} = P_{Io_2} - \frac{F_{O_2}}{F_{total}} * (P_{atm} - P_{H_2O}) \quad 12$$

$$P_{avco_2} = \frac{F_{CO_2}}{F_{total}} * (P_{atm} - P_{H2O}) \quad 13$$

$$P_{N_2} = \frac{F_{CO_2} * 2.9}{F_{total}} * (P_{atm} + P_{H2O}) \quad 14$$

$$P_{ar} = P_{Io_2} - \frac{F_{O_2} * 2.9}{F_{total}} * (P_{atm} - P_{H_2O}) \quad 15$$

The analysis of equation (12 to 15) inhale and exhale gases of data is mention in table.1

Gases	Inhale data in terms of mm H_g	Exhale data in terms of mm H_g
Nitrogen (78.08 %)	593	588
Oxygen (20.95 %)	159	101
Carbon dioxide (0.04%)	0.304	40
Argon (0.9 %)	6.94	12
Inert gases (0.03%)	0.756	19

Table.1

The analysis of equation (12 to 15) is exhale gases of volume, the main function of circulatory system in lungs is exchanging of gases from inhale it takes for blood to transport gases from the lungs to the systemic tissues and from the thoracic veins back to the pulmonary capillaries. Gas transport throughout the venous pool is instead explicitly modeled since blood flow in the Venous section is typically slow and hence this section accounts for most of the circulatory Blood transport to exhale, respiratory system exchange the gages of oxygen every cell in our body needs to energy to function.

The above things are functioning properly well but in case of any gases increase or decreases the total respiratory system will changes and respective health issues occur. Here three gases are mostly effecting those are oxygen, carbon dioxide and argon. The oxygen inhale 20.95 percentage exhale 16 percentages 5 percentage of oxygen decreases the alveoli functioning properly, the carbon dioxide inhale 0.04 percentage and exhale 4 percentage here the alveoli taking some action pumping to blood to body properly. Once the exhale of oxygen 18 percentages is increase the functioning of respiratory system disorders of respiratory system due to some health issues occur like Asthma, Emphysema. The asthma people are a difficulty to breathing causing wheezing due to tenderness of bronchi and bronchioles. Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased. One of the major causes of this is cigarette smoking. It may affect some reasons, the argon and inert gases also there standard property may change, some of dieses are dizziness, headache, dullness, nausea, vomiting, and loss of consciousness.

4. Design and implementation of Detection of exhale analysis system

The proposed system is Design and implementation of Detection of exhale analysis system using Arduino and integrated sensors to monitor and observe the exhale analysis of gases, the analysis are like Nitrogen (78.08 %), Oxygen (20.95 %), Carbon dioxide (0.04%), and Argon (0.9 %), and display corresponding exhale composition gases with each gas of information, the person is normal and abnormal depending on gas composition of exhale density. The proposed system consists of various sensors integrated to Arduino board. The Arduino board gets the results from various sensors and processed display to persons. The developed system systematically monitors the gases Parameters to get down various results so that early detection of dieses symptoms is possible. The block diagram of Detection of exhale analysis system of the proposed system is shown in Fig 1.

Figure.2. Detection of exhale analysis system

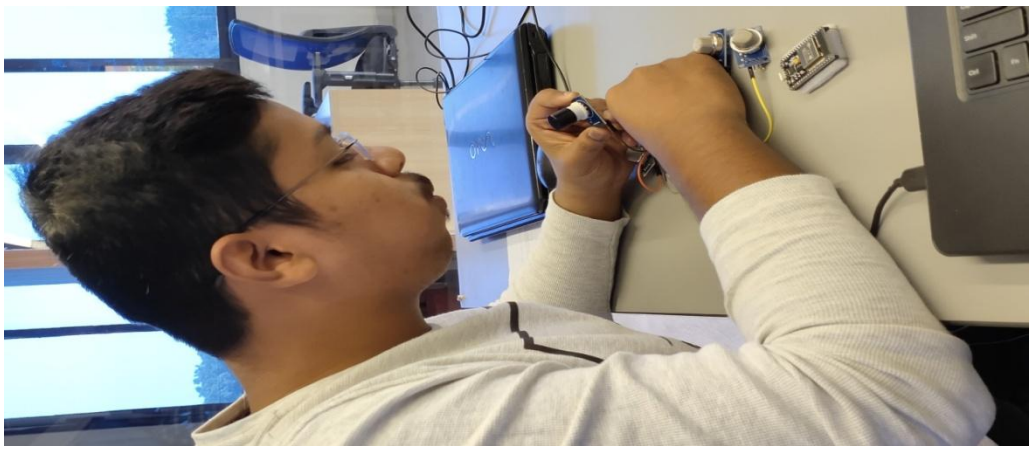

Figure.3.Detection of exhale analysis system

The figure 3 is shown above, the person is can able to test their own at any time and any place the environmental and person functioning like normal and abnormal conditions of ambient air and person exhale.

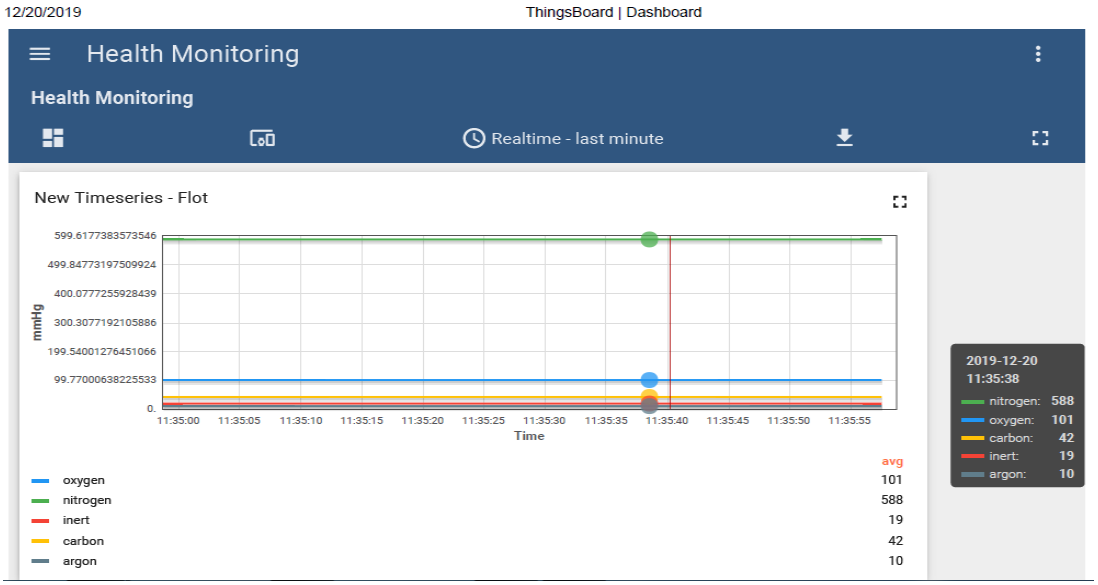

Figure.4. exhale normal

The figure 4 shown in above the exhale normal, the position of environmental air, respiratory system and transportation and exchanges of gases like oxygen to every cell to body, our body needs to energy to functioning.

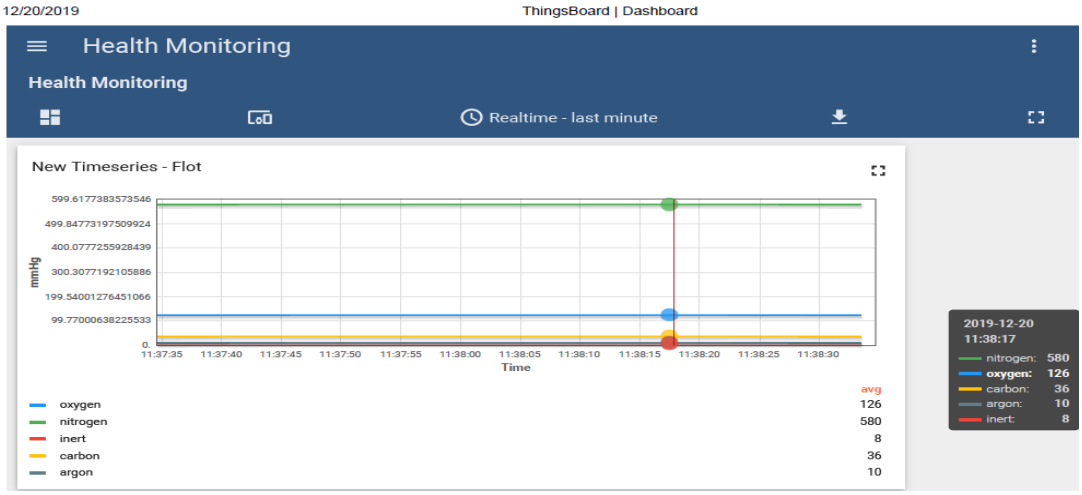

Figure.5. exhale abnormal

The figure 5 shown in above the exhale abnormal, the position of environmental air, respiratory system and transportation and exchanges of gases changes, the above figure real time exhale reading mentioned oxygen exhale is 126 mm Hg, here persons respiratory system and transportation and exchanges of gases disorder, it's may happened some sickness. Due to less oxygen exchange, the less oxygen exchange means the Exchange of O2 and CO2 at the alveoli and tissues occur by diffusion. Rate of diffusion is dependent on the partial pressure gradients of O2 (pO2) and CO2 (pCO2), their solubility as well as the thickness of the diffusion surface. These factors in our body facilitate diffusion of O2 from the alveoli to the deoxygenated blood as well as from the oxygenated blood to the tissues. The factors are favourable for the diffusion of CO2 in the opposite direction, i.e., from tissues to alveoli. Oxygen is transported mainly as oxyhaemoglobin.

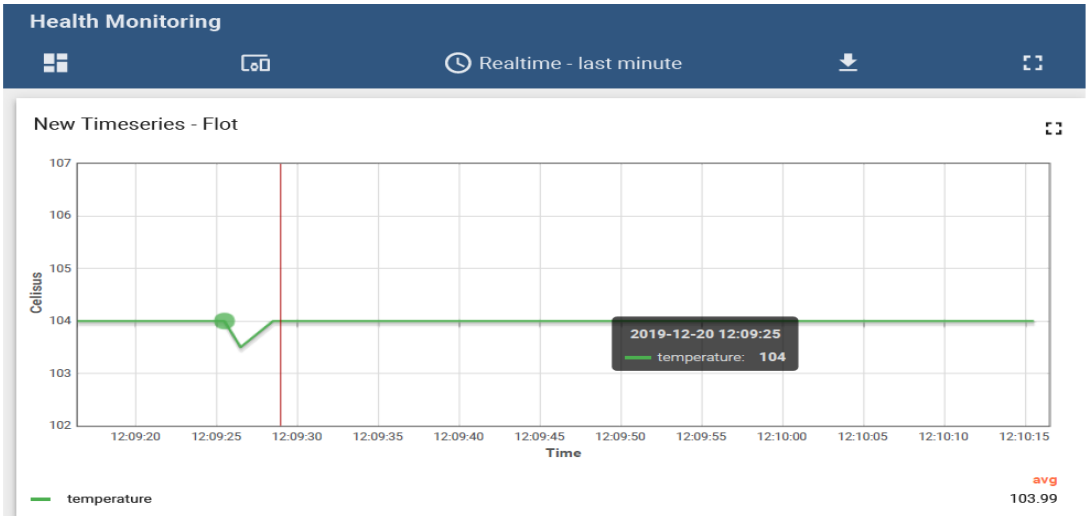

Figure.6. exhale temperature abnormal

The figure 6 is shown above exhale temperature abnormal , the person is can able to test their own at any time and any place the environmental and person functioning like normal and abnormal conditions of exhale temperature abnormal.

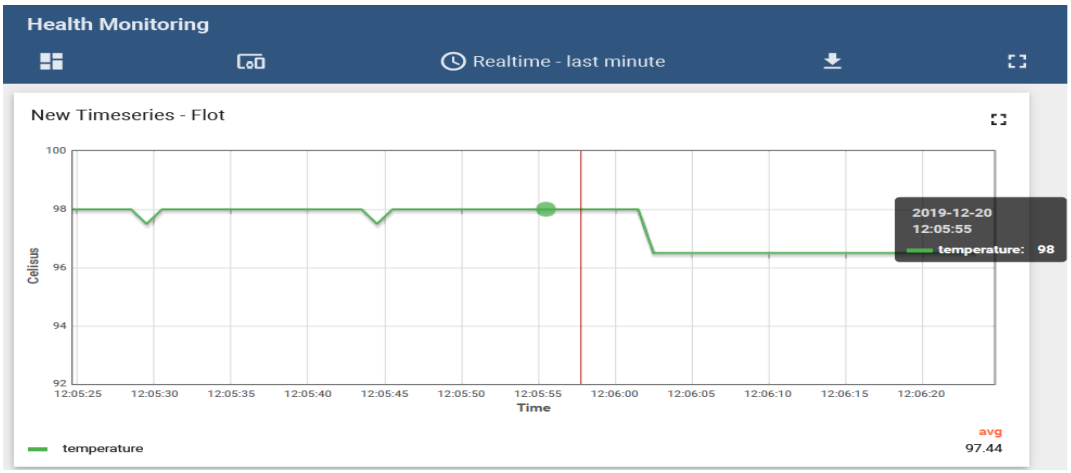

Figure.7.exhale temperature normal

The figure 7 is shown above exhale temperature abnormal , the person is can able to test their own at any time and any place the environmental and person functioning like normal and abnormal conditions of exhale temperature normal.

5. **Conclusion**

The primary objective of work is Mathematical analysis; simulation and practical results are observing a Detection of exhale analysis system.

The Mathematical analysis was optimized using atmosphere pressure flow of 760 mm H_g standard. Here assuming atmosphere pressure flow is exhale pressure flow, through exhale pressure flow mixtures of gases accurately mathematical formulas are derived and simulate results are performed by using Matlab software.

The proposed system is Detection of exhale analysis system for exhale monitoring and determines the gases in exhale. This system finds the various parameters and determines the level of seriousness environmental and person body functionality. The proposed system verified mathematical analysis, simulation results and practical are observed almost are near results.

6. **Reference**

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