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Research Article

HUMAN BREATHING RATE MEASUREMENT TECHNIQUES

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ABSTRACT

In today's world regular monitoring of disease is necessary and more over when, it is related to our respiration rate. There are ample numbers of medical devices developed to keep check on human health condition. Vital signs are measurements of the body's most simple functions. Vital signs in our body are Blood Oxygen level, Temperature, Heart Rate and Breath Rate. Vital signs can be measured in a medical setting, at home, at the site of a medical emergency, or elsewhere. The System uses data acquisition of vital signs using non-invasive approach, wireless transmission of the data, results display and their interpretation. Health of a Patient can be monitored based on vital signs. Vital signs can be used to monitor patient's health condition. This paper aims at the techniques used to measure respiration rate of human body for example digital temperature sensor, thermistor etc., and the respiration rate is measured with the help of temperature sensor a Digital temperature sensor which monitor the little change in temperature during inhalation & exhalation.

INTRODUCTION

Biomedical Engineering is a study that utilizes ideas and principles of the many engineering domains to postulate ideas and techniques helpful in planning and constructing a range of health care products. There are number of biomedical devices that are in current use, all aiming at improving human health and welfare [1]. The respiratory rate (RR) is the number of breaths taken within a set amount of time (typically 60 seconds) [2]. Vital signs are used to measure the body's most fundamental capacities. As we all know there are four very important signs that are used for monitoring the health of the patient they're pulse rate, blood pressure and body temperature, respiratory rate. The respiratory rate is one in all the foremost of 4 very important signs that are considered the main reason for monitoring patients on acute hospital wards. Unusual respiratory rates in the subject's body decide the serious medical actions like cardiopulmonary arrest. If the respiratory rate goes above 27 respiration/min then it's the principally important analyst of cardiopulmonary arrest [3].

During the respiration there will be a change in the temperature of the respired air, moisture, chemical composition of the air, and in its volume. The breathed out air is normally warm than the air that is inhaled by around 2-3°C much of the time. The inhaled air is at the room temperature which is normally around 25°C (70°F), and the exhaled air has a temperature of around 28°C (82.4°F). If the inhaled air is warmer, then the heat lost from the subject's body during the respiration process is lesser [3].

Inhaled air contains dihydrogen oxide vapour, however is rarely immersed. The exhaled air is proximately immersed for the temperature at that it leaves the body. During this method, the exhaled air picks up dihydrogen oxide vapour and carts it far away from the lungs [3].

Breathing builds up a transmutation within the chemical composition of the air. Breathed in air embodies around 20.947% of oxygen (O2) and 0.033% of greenhouse gas (CO2) by volume, although the breathed out air contains 15.4% of gas (O2) and 4.3% of carbon dioxide (CO2) by volume. Breathed out air contains unstable natural substances in vastly minute amounts [3].

Breathed out air is in more volume than breathed in air since it has water vapour added to it, as well as is expanded in outcome of its high temperature. In the event that, not withstanding, it is dried and decreased to the similar temperature as the inhaled air, its volume will be found to reduce, since it has lost 5.4 volumes of O_2 for each 43 volumes of CO_2 which it has picked up [3].

Existing Measurement Techniques

There exist several techniques for measuring of human respiration rate. The human respiration rate is typically

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measured when someone is at complete rest and it merely involves counting the amount of breathes for one minute by counting the amount of times the chest expand and contracts. Respiration rates might usually increase if patient is suffering from illness, or different medical conditions. While checking respiration, it's vital to additionally note whether or not the patient has any problem in breathing.

Average rate reportable in an extremely healthy adult at rest is usually given as twelve breaths per minute (12⁄60 Hz) but estimates do vary between sources [4], e.g., 12–20 breaths per minute, 10–14, between 16–18, etc. With such a slow rate, further correct readings are obtained by investigating the number of breaths over a full minute.

The commonly used technique for measuring of respiration rate is investigation the number of respirations per minute. Jointly sorting nurses' measurements [5] of rate show low sensitivity in detection of Bradypnea (a condition of slow breathing) and Tachypnea (a condition of fast breathing). Some techniques developed to live respiration rate include:-

- Respiratory rate measurement using Piezoelectric Sensor (PZO).
- Respiratory rate measurement from Laser Doppler Vibrometer (LDVi).
- Respiration rate measurement System Using Pyro electric Sensor.
- Impedance pneumography method.
- Capnometry.
- Respiratory rate measurement using PPG signal.
- Respiratory measurement using temperature sensor

But these techniques have some drawbacks such as

1. Low sensitivity
2. Inaccuracy and
3. High cost of implementation and maintenance.

Respiratory rate measurement using Piezoelectric Sensor (PZO)

- Piezoelectric sensors are used to detect respiratory effects, utilizing the piezoelectric property.
- It directly measures the electrical potential changes created when the piezoelectric ceramic is wedged by respiratory flow of air.
- Piezoelectric film sensor made of aluminium nitride (AlN) material has good sensitivity [6].

Respiratory rate measurement from Laser Doppler Vibrometer (LDVi)

- LDVi could be a totally no-contact measuring technique for monitoring of the respiration rate.
- This technique is operated at a distance of 3m, on completely different point of the patient thoracic and abdominal area [7].
- Laser dopplervibrometers can effectively find vibration within 200 meters with a sensitivity on the order of 1 (mm/s)/V.
- The laser sensor works with a He–Ne laser source.
- No necessary special safety precautions are needed since laser power is less than 1mW [8].

Respiration Rate Measurement System Using Pyro electric Transducer

- A polyvinylidene fluoride (PVDF) has quicker response time than those of traditional thermal devices.
- A PVDF film has each piezoelectric and pyroelectric property.
- The distinction of temperature is often best detected by using PVDF placed ahead of the nostrils by means of an appropriate device [9].

Impedance Pneumography Method

- The objective of this system is to measure changes within the electrical electrical resistance of the person's thorax caused by respiration or breathing.
- In each of these ways, a high-frequency ac current is injected into the tissue through the drive electrodes.
- This potential difference is related to the resistance of the tissue between the voltage-sensing or receive electrodes.
- The equivalent resistance is defined because the ratios of the voltage distinction between the 2 receive electrodes and therefore the current that flows through the tissue [10].

Capnography

- The measurement relies on the absorption property of infrared rays by certain gases (like carbonic acid gas, CO, and NO2).
- When infrared rays are passed through the expired air containing a precise quantity of carbonic acid gas, a number of the radiations are absorbed by it.
- The detector changes the loss in heating impact of the rays into an electrical signal [11].

Respiratory rate measurement using PPG signal

- Photoplethysmography (PPG) is the measuring of blood volumetric changes with every heartbeat.
- The PPG pulse obtained by the optical device is employed for numerous cardiovascular parameter measurements.
- Frequency domain analysis of PPG signal shows 2 peaks 1st around zero.25 to 0.35Hz and second at around one to one.5Hz [12].

Respiratory measurement using temperature sensor

- The measurements are done by using temperature sensor.
- The sensor is placed in front of nostril in a mask.
- The sensor then senses the difference in temperature of inhaled air and the breathed out air.
- And it also counts respiration rate/minute.
- The result can be seen digitally on LCD screen or mobile phone [13].

CONCLUSIONS

This paper presents a replacement technique for monitoring changes within the breathing temperature to calculate respiration rate. The primary objective of the analysis was to look at the effectiveness of employing a non-contact,

straightforward and low price detector for accurately measuring breathing rate. Overall, the results obtained from experiments are very promising. Information from the typical test sets clearly demonstrate that a temperature detector, once accurately positioned, will observe delicate temperature changes comparable to inspiration and expiration. Given the small size of the detector and therefore the minimal computation needed for non-contact breathing watching (as compared to existing methods), this analysis demonstrates the utility of this sensing modality for RR .Preliminary experiments highlighted limitations with the ways accustomed position the detector, collect ground truth and automatically compute breathing rates, however it's our expectation that they're going to be fairly simple to overcome. Collecting ground truth will be accomplished employing a respiratory belt transducer or thermistors. Future experiments can engage the study participant in a very light activity that may need minimal movement whereas breathing is monitored. Additionally, sensitivity analysis of inaccurate nose detection and an examination of the possible cross-effect of perspiration within the perinasal region are going to be considered in future tests.

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