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MULTIPARA MONITORING AND ALERTING FOR NEONATAL INTENSIVE CARE UNITS USING ZIGBEE AND LAB-VIEW

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Abstract: **Electrical impedance pneumography has been suggested as a possible means to noninvasively monitor rate of breathing the use of impedance pneumography as a technique to measure respiration rate. The generation of high-frequency ac current source is described, and the issues related to delay in modulated signal and finite transition times of carriers are addressed. The report also includes descriptions of potential implementations of a respiration rate measurement system using the AD 5933 and the respective respirative impedance measurement . It is concluded that, at this stage of development, the ZPG may be useful mainly as an apnea detector and rate of breathing monitor.**

1. INTRODUCTION

Apnea is characterized by the cessation of airflow for 10 seconds or longer. Although there is almost universal consensus regarding the definition of apnea in adults, the presence of hypoapnea continues to be identified using various criteria, including (1) a 50% reduction in airflow accompanied by a 4% fall in oxygen saturation (SaO2) or an arousal, (2) a 50% reduction in airflow accompanied by any fall in SaO2, or (3) any reduction in airflow with or without oxygen de-saturation or arousal Respiration has been of interest historically to psycho-physiologists. Although respiration has received little attention as a direct marker of psychological activity, it has been linked to information acquisition and emotion. Moreover, its contribution to respiratory sinus arrhythmia RSA, is of considerable importance in deriving noninvasive measures of parasympathetic control from patterns of heart rate variability. Unfortunately, direct Spiro metric measures of respiration require a mask or mouthpiece that may be intrusive in psychological studies, and the requisite equipment can be expensive

Sleep is essential for humans although its basic physiological function remains obscure. Disturbance of the normal breathing process can cause the development of severe metabolic, organic central nervous and physical disorders. Respiration monitoring allows the continuous measurement and analysis of breathing dynamics and thus, the detection of various disorders. There are a number of breathing disorders, but *sleep apnea syndrome* (SAS) is probably the most common amongst them. Sleep apnea is defined as cessation of airflow to the lungs during sleep for 10 sec. or more. The sleep-related breathing disorders have been categorized in various ways. The most basic schema divides them into obstructive or central apneic events. OSAHS is characterized by repetitive reduction or cessation of airflow during sleep caused by partial or complete upper airway occlusion in the presence of respiratory efforts. Mixed apnea, in which an initial period of apnea caused by an absence of respiratory efforts precedes upper airway obstruction, is included in this syndrome. The monitoring of breathing dynamics is an essential diagnostic tool in various clinical environments, such as sleep diagnostics, intensive care and neonatal monitoring.
Accurate monitoring of respiration during sleep, including measurements of airflow, respiratory effort, oxygenation, and ventilation, is indispensable in identifying sleep-disordered breathing.

2. WORKING PRINCIPLE

Impedance pneumography employs low amplitude, high frequency (50 to 500 kHz) alternating current (AC) between two surface electrodes to record thoracic movements or volume changes at the rib cage (RC) during a respiratory cycle. Based on Ohm’s Law, the voltage drop across the electrodes is computed as impedance, which increases during inspiration and decreases during expiration. This causes proportional changes of electrical impedance. The impedance is found by introducing an electric current in the frequency range of 20 –100 kHz to the volume conductor and measuring the corresponding voltage. The ratio of voltage to current gives impedance Z. The conductivity of the lung tissue is a function of the ratio of air volume to fluid volume and hence, undergoes a change during breathing. These changes in lung conductivity combined with changes in thoracic geometry cause the impedance of the thoracic cavity to change during breathing. Impedance pneumography is a technique to monitor breathing by measuring impedance changes of the thoracic cavity.
Separate electrode pairs for introducing the current and for measuring the voltage should be used. An example of placement of four band electrodes is shown in fig.2. In particular arrangement of the outer pair, one electrode is placed around abdomen and the other around the neck. For the

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inner pair, one electrode is placed around the breast, and the other around the neck.

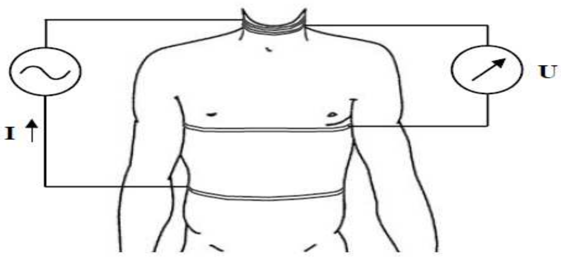


Fig. 2. Placement of electrodes using impedance pneumography technique

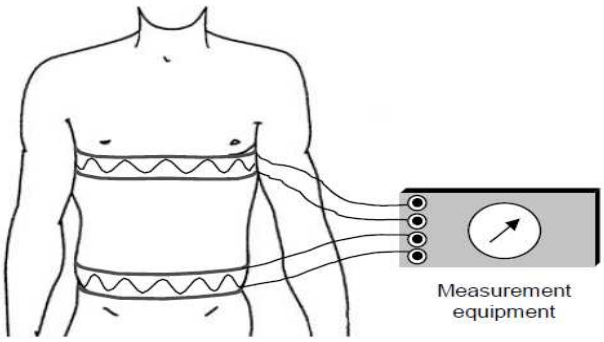
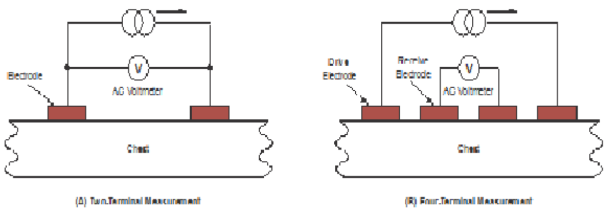
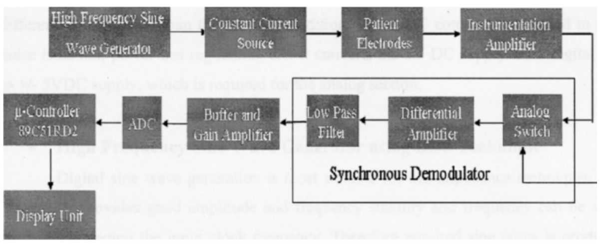


Fig. 3. Placement of respiratory band sensors

A noninvasive method for monitoring the respiratory patterns of the patients and the specifications of apnea monitor and implementation of hardware is described. The microcontroller is used for interpretation of the signal to detect the apnea.



The functional blocks of the system are as shown below.

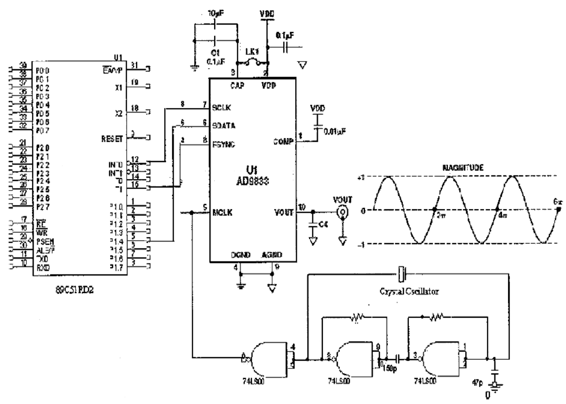


The main target of these systems is personal and home monitoring. Analog Devices has made available AD5933, a new system-on chip fully integrated electrical impedance spectrometer, which might allow the implementation of minimum-size instrumentation for electrical bioimpedance measurements.

The AD5933 is a high precision impedance converter system (see Figure 1) that combines an on-board frequency generator with a 12-bit, 1 MSPS, analog-to-digital converter (ADC). The frequency generator allows an external complex impedance to be excited with a known frequency. The response signal from the impedance is sampled by the on-board ADC, and a discrete Fourier transform (DFT) is processed by an on-board DSP engine.

3. AMPLITUDEMODULATION/DEMODULATION

As explained earlier, impedance pneumography requires injecting current into the body. The ANSI/AAMI standard allows injecting up to 100 µA of current at 10 kHz. At lower frequencies, of course, the current that can be injected into the body is lower. For respiration, a high-frequency ac signal is injected into the body; this signal acts as a carrier that is amplitude-modulated by the low-frequency signal (ΔV) generated as a result of the breathing action. On the receiver side, this modulated signal must be demodulated in order to extract the low-frequency breathing signal. After demodulation, the signal is low-pass filtered to the 2-Hz to 4-Hz bandwidth level to remove unwanted noise. The demodulated and filtered output, generally, is then digitized by a The carrier at frequency F_C can beeither sine wave or square wave. The demodulation is accomplished with a square wave signal at thesame frequency. Capacitor C_T blocks any dc current from reaching the body on the transmission side,while capacitor C_R is used for the same purpose on the receiver side. Ideally, we prefer to keep thiscapacitance as small as possible so that at line frequencies (50 Hz to 60 Hz), any impedances looking from the body to both the transmitter and receiver sides are high. In practice, however, the capacitors are chosen to be large enough so that the carrier is not significantly attenuated.



microcontroller transmits data in 8-bit bytes, thus only eight falling SCLK edges occur in each cycle. To load the remaining 8 bits to the AD9833, P3.5 is held low after the first 8 bits have been transmitted, and a second write operation is initiated to transmit the second byte of data. P3.5 is taken high following the completion of the second write operation. SCLK should idle high between the two write operations.

The microcontroller outputs the serial data in a format that has the LSB first. The AD9833 accepts the MSB first (the 4 MSBs being the control information, the next 4 bits being the address, while the 8 LSBs contain the data when writing to a destination register). Therefore, the transmit routine of the

80C51/80L51 must take this into account and rearrange the bits so that the MSB is output first.

4. CONCLUSION

The developed system recognized three SAS types and extracted one minute before and after the apnea by monitoring the time-frequency analysis automatically. The system can be used at home and be self-applied by suspected apnea patients for monitoring SAS episodes during sleep under familiar circumstances. Pulse and respiratory rate are two primary physiological parameters that should be always controlled using active clothing ant wearable technologies systems for worker's health state control and accidents preventive purposes at work. Body temperature might be used as additional parameter for health state estimation.The physiological parameters monitoring system proposed, enables registering of pulse and respiratory rate of workers and sending physiological data to remote center, where his health state is evaluated

5. REFERENCES

[1]. Texas *instrument Respiration Rate Measurement Based on Impedance Pneumography- amit gupta (2011)*
[2]. Prutchi, D. and M. Norris. (2004). Design and development of medical electronic instrumentation: A practical perspective of the design, construction, and test of medical devices. Hoboken, NJ: Wiley Interscience.
[3]. Grenvik, A., Ballou, S., McGinly, E., Cooley, W.L., and P. Safar. (1972). Impedance pneumography: Comparison between chest impedance changes and respiratory volumes in 11 healthy volunteers. *Chest*, vol 62, pp. 439-443.
[4]. Kelkar, S.P., Khambete, N.D., and S.S. Agashe. (2008). Development of movement artefacts free breathing monitor. *Journal of the Instrument Society of India*, vol. 38, pp. 34-43. 10
[5]. Nyboer J, et al: The impedance plethysmograph: An electrical volume recorder. National Research Council, Committee on Aviation Medicine Report Number 149,
[6]. Cooley WL, Longini RL: A new design for an impedance pneumograph. J Appl Physiol25:429-432,
[7]. Pacela AF: Impedance pneumography: A survey of instrumentation techniques. **Med** Biol Engin 4:l-15, 1966