Apprehension of Sleep Apnea in Aged and Infants

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***Abstract*—In sleep apnea people pause while breathing in their sleep . In this paper a method is proposed, that can accurately detect breathing through repiratory rate and issue appropriate warnings upon its cessation. The paper propose the design of system which can be used in two ways**

- **To detect if any random person have sleep apnea or not. The intervals between breathing are detected and that data is made available to the user for further medical diagnosis.**
- **To detect sleep apnea for infants, aged and people with severe medical condition and to provide an alert or alarm if the breathing pauses more than 20 seconds.**

***Index Terms*—Sleep apnea, Obstructive sleep apnea, filter, mask.**

I. Introduction

Obstructive sleep apnea (OSA) is a common sleep disorder. It is characterized by partial or complete upper airway collapse during sleep. Interruption of airflow leads to disruption of gas exchange and thus causes sympathetically driven recurrent arousal from sleep. Affected individuals frequently manifest excessive daytime sleepiness, cognitive dysfunction as well as decreased health-related quality of life[1]. Classical OSA symptoms include snoring and intermittent breathing pauses during sleep leading to frequent arousal(fig.1), yet many patients are unaware of these symptoms and disease onset is insidious. The long-term effects of sleep fragmentation

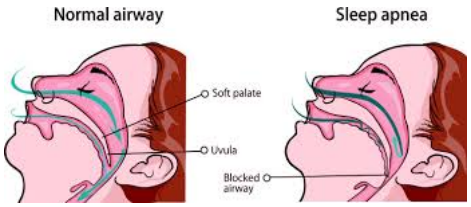

Fig. 1. Sleep apnea

and intermittent hypoxia on health are numerous leading to systemic hypertension, impaired glucose metabolism and cardiovascular disease, as well as societal effects such as increased car accidents.This is as demonstrated in fig.2

Aging is known to be an important factor contributing to the risk of OSA, with rising disease prevalence across a wide spectrum of ages. A recent large study demonstrated that 50 % of aged people had a respiratory disturbance with aging being

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Fig. 2. Health issues associated with sleep apnea

an independent risk factor. In some but not all studies, OSA is a cause of increased mortality in older adults, with one large study demonstrating that patients older than 70 years with severe OSA have a significantly shorter survival time. However, the mechanisms whereby aging increases the risk of OSA are not completely understood. OSA occurrence with aging may be driven by one or more of the physiological characteristics known to be important in OSA pathogenesis, with four of the most recognized factors being a poor upper airway anatomy , ineffective upper airway dilator muscle activity/responsiveness, a low respiratory arousal threshold, or an unstable ventilatory control system.First line therapy for adult OSA has been in the past continuous positive airway pressure (CPAP), with surgery gradually taking on a more prominent role as evidence demonstrates benefit at or superior to CPAP in anatomically favorable patients[2].

Sleep-disordered breathing (SDB) is a spectrum of upper airway disorders ranging in severity from primary snor- ing to obstructive sleep apnea (OSA)[3]. OSA, which affects 1 to 3 percent of children,is characterized by periodic obstruction of the upper airway that interferes with normal respiratory gas exchange and disturbs sleep.Children with OSA often present with a clinical picture of snoring and witnessed apneas[4]. If not treated, OSA can result in significant physiologic sequelae including cardiorespiratory impairment and growth retardation[5].

II. Proposed System

In this paper a breath detection system is modelled with an intention to be able to detect the breathing disorder of an infant or aged. By being able to detect breathing it can be noticed when it stops and for how long, this is important

due sleep apnea. This can potentially be hazardous, especially for infant,premature babies and aged people. Apnea events are classified as cessation of breathing at least 20 seconds or longer.

III. System Work Flow

The overall design involves acquiring sound from a microphone ,this sound is then processed to detect breathing and generates the graph corresponding to it.A timer counts the interval between breaths.When an apnea event occurs,longer than 20s without breath an alarm is turned on.

The main blocks are microphone,ADC,level shifter,VHDL filter,timer,alarm,etc.Microphone acquires sound .This sound is then processed to detect breathing.As this sound is is in analog form it is required to convert to digital form.For this an analog to digital converter is used.Before converting to digital form we have to use a level shifter.Sound from a microphone has both positive and negative voltages.A level shifter shift the microphone output to all positive voltages.So it could read by the ADC .A VHDL filter can be used.A clear information sufficient to detect breathing can be obtained but reduces the influence of external noise.It also provides the envelop of the signal rather than just a filtered waveform.This allows for simple peak detection can be done with software.The obtained result is compared with the standard respiratory rate graph.The correlation is computed.If correlated, then the timer is updated.If uncorrelated,warning alarm reaches to set limit and alarm is turned on. There is calibration and averaging of

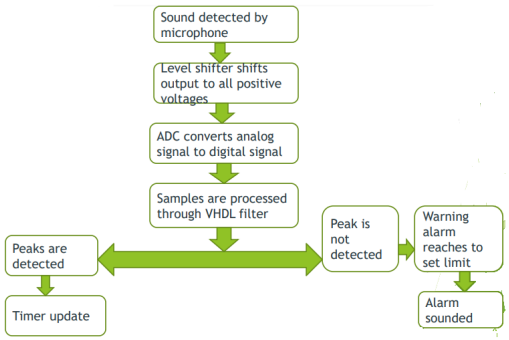

Fig. 3. The flow chart of proposed design

these peaks to ensure no peaks below the level of breathing are falsely detected as breaths.A record of time between breaths is kept and as this reaches various lengths appropriate warnings are issued,with an audible alarm in the case of apnea event.The flow chart is as shown in fig.3

IV. Software Simulation

A software simulation had been made to detect sleep apnea in both aged and infants from the resipiratory chart of the individual.

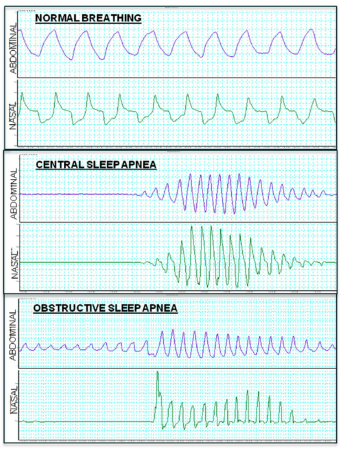

Fig. 4. Respiratory chart

In the software simulation, the graph of normal breathing is kept as standand, which is used for comparing with the actual breathing chart of the individual. The level of correlation is computed.If both the images are not correlated, then the alarm circuitry is turned on,indicating that the individual has sleep apnea.

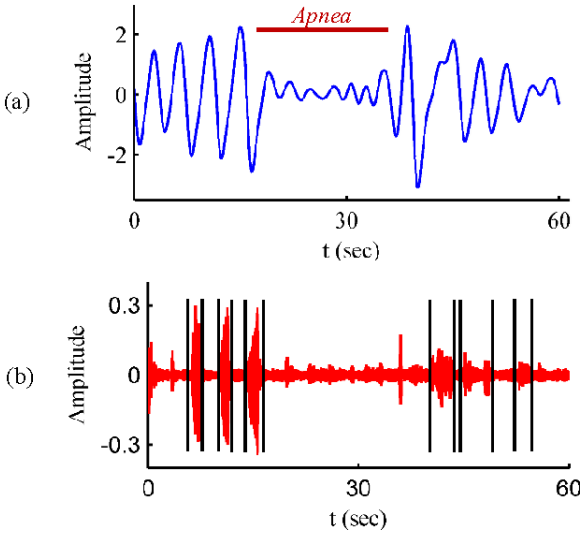

Fig. 5. Respiratory chart of an apnea patient

V. Simulation Results

The output of the filter modelled using MATLAB software is as shown in fig5. Simple peak detection can be done with software.If peaks are detected then the timer is updated.If peaks are not detected,warning alarm reaches to set limit and alarm is sounded. The correlated output of the standard

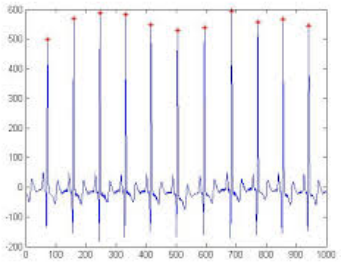

Fig. 6. Peak detection

Fig. 9. Proposed model of detector

respiratory graph and the actual graph of the individual is also plotted for a time duration. The peak indicates a high level

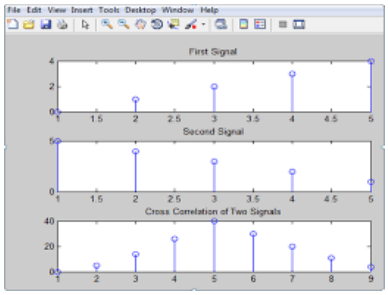

Fig. 7. Correlation plot

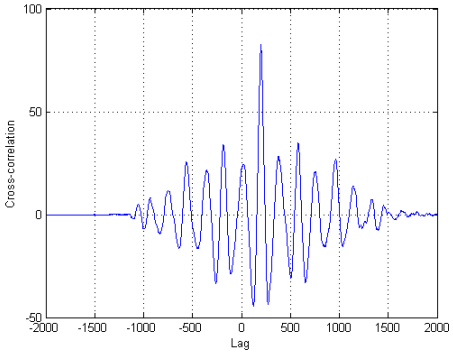

Fig. 8. Correlation plot

of not being correlated.Thus the presence of sleep apnea can be ensured.

VI. The Proposed Model

A mask type device is proposed to implement the software simulated model. The device can be mounted on the face of the individual subjected to test.

VII. Conlusion

The presence of sleep apnea in both aged and infants has be detected with the help of respiratory rate chart and MATLAB software . The proposed software model can be implemented into hardware which can be deployed for the apprehension of obstructive sleep apnea in both infants and aged.The associated alarm circuitry enables the indication at proper time.

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