2022 IEEE 6th International Conference on Condition Assessment Techniques in Electrical Systems (CATCON) | 978-1-6654-7380-4/22/$31.00 ©2022 IEEE | DOI: 10.1109/CATCON56237.2022.10077645

Proceedings of
2022 6th International Conference on Condition Assessment Techniques in Electrical Systems (CATCON 2022)

Dec 17-19, 2022

Local Host:
Department of Electrical Engineering,
National Institute of Technology, Durgapur,
India

ISBN 978-1-6654-7380-4
PART NO. CFP2220V-ART

Edited by:

Chiranjib Koley
Parth Sarathee Bhowmik
Aashish Kumar Bohre
Aniruddha Bhattacharya
Biswendu Chatterjee

DEIS

IEEE
KOLKATA SECTION

Hybrid Mode Conference

2022 IEEE 6th International Conference on Condition Assessment Techniques in Electrical Systems (CATCON) | 978-1-6654-7380-4/22/$31.00 ©2022 IEEE | DOI: 10.1109/CATCON56237.2022.10077646

Table of Contents

2022 IEEE 6th International Conference on Condition Assessment Techniques in Electrical Systems (CATCON)

ISBN: 978-1-6654-7380-4

PART NO.: CFP2220V-ART

ISBN: 978-1-6654-7380-4

PART NO.: CFP2220V-ART

Wireless Sensor and Smartphone-based System for Detection of Sleep Apnea

Dr. Bijoylaxmi Koley,
Department of Electrical Engineering,
DR. B C Roy Engineering College,
Durgapur, India
bijoylaxmi.koley@bcrec.ac.in

Mr. Saradindu Mandal
Department of Electrical Engineering,
DR. B C Roy Engineering College,
Durgapur, India
saradindu.mandal@bcrec.ac.in

***Abstract*— This study describes a real-time system to identify apnea or hypopnea events that occur during sleeping of the sleep apnea patient. The suggested solution uses a smart phone's Bluetooth communication interface to transfer respiration data from a oronasal temperature sensor. A SVM-based binary classifier was built in the smartphone to categories a typical eight-second buffered/windowed respiratory signal into the normal (N) and disordered (D) breathing states. A high priority interrupt loop that interrupts every two seconds updates the buffer while also calling the feature calculation and classification subroutines during each interrupt cycle. In this way, the relevant period is recognised as an apnea/hypopnea event if the classifier's five consecutive decisions are judged to be disordered (D). With the aid of the SVM-based Recursive Feature Elimination (RFE) technique, a set of seven features were screened from the initially selected set of 20 features. During the testing procedure, it was discovered that the suggested system's event detection accuracy was 90.1%. The suggested smart phone-based system can also initiate an alarm when an event lasts longer than 10 seconds and can interact in real time with a remote computer using the global GPRS/UMTS wireless network.**

***Index Terms*—Apnea-hypopnea index, real-time monitoring, respiration signal, support vector machine.**

I. Introduction

Obstructive sleep apnea (OSA) is a widespread sleep condition marked by repeated breathing pauses brought on by the partial (hypopnea) or total (apnea) collapse of the upper airway while the patient is asleep [1]. According to estimates, OSA affects 4% of adult males, 2% of adult women, and 3% of children [2]. Daytime drowsiness, irritability, exhaustion, decreased attention, and impaired learning are among the main symptoms of OSA [3]. Diurnal hypertension and numerous other potentially catastrophic cardiovascular disorders are caused by severe OSA [4]. Early detection and treatment are therefore crucial to minimizing the negative health effects.

The most accurate way to diagnose OSA is using polysomnography (PSG). It involves nocturnal electrophysiological signal recording in sleep research labs [5]. The number of apnea and hypopnea events per hour of total sleep time is counted in PSG to provide a conclusive diagnosis of sleep apnea. PSG is a pricey, drawn-out, and labor-intensive operation, though. As a result, numerous methods for streamlined sleep apnea diagnosis appropriate for screening tests at home or in a lab setting have been developed [6-7]. Numerous single-channel airflow measurement-based approaches have been developed for home-based automated OSA assessment [8-12] because nasal air flow recorded using thermal sensor gives major indicator of apnea occurrences when the other signals provide supplementary evidence. All of the remedies suggested by these methodologies are focused on the entire diagnosis of OSA and are off-line physiological signal analyses, nevertheless. The real-time detection of apneic episodes in recorded signals was not possible with these techniques.

According to earlier research, OSA can exacerbate conditions such as hypoxemia, hypercapnia, cardiac arrhythmias, ischemia, and encephalopathy in the perioperative period. In order to make it easier to deploy interventions to reduce postoperative risk, real-time OSA screening is required during preoperative examination. The home apnea monitoring of preterm newborns is another situation where real-time apnea monitoring is interesting since they are more vulnerable to OSA and its manifestations. Recently, real-time apnea monitoring systems have been developed employing PPG and blood oxygen saturation and [13]. Recently, alternative methods for detection of sleep apnea have also been proposed such as respiratory effort based detection [14], RR interval of ECG signal [15], nocturnal Pulse Oximetry [16], pressure sensitive mat [17], and chest bio-impedance based [18]. However for clinical acceptability as per AASM standard [5], oro-nasal airflow is mandatory.

In this context, the current effort intends to develop an smart phone-based real-time apnea monitoring system through the measurement of oronasal airflow signal that is easier, dependable, and affordable. The proposed system leverages a smartphone for real-time physiological data collecting, display, and analysis for sleep apnea screening. Additionally, it enables the real-time transmission of physiological data to a doctor or sleep centre. Because of the smartphone's growing processing power, portability, ease of use, built-in Bluetooth compatibility, low power consumption, and ability to connect to GPRS/HSDPA or the Internet, it is now preferred as a platform for real-time monitoring. In the study, a smartphone was used to capture the airflow signal recorded by a thermistor. A predetermined time period (window) of this data was then

B. Koley is with Department of Electrical Engineering, B. C. Roy Engineering College, Durgapur, West Bengal, 713209, India (e-mail: bijoylakmikoley@yahoo.com).

\.