A Non-Intrusive And Portable System For Assessment Of Sleep Apnea

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SUMMARY

UCLA researchers in the Department of Computer Science have designed an affordable and completely non-intrusive system that can serve as a screening tool for obstructive sleep apnea.

BACKGROUND

Obstructive sleep apnea (OSA) is a very common chronic sleep disorder. OSA is characterized by recurrent collapse of the tongue and throat muscles against the soft tissue in the upper airway of the throat, causing a substantially reduced or complete cessation of airflow despite ongoing breathing efforts during sleep. OSA patients experience repeated pauses in breathing during sleep and fragmented sleep pattern, which can result in memory impairment, cognitive changes, excessive daytime sleepiness and fatigue. OSA patients are also at increased risk for poor neurocognitive performance and adverse medical outcomes if symptoms were not appropriately managed over a long period of time.

Currently, polysomnography (PSG) is the gold standard for diagnosing sleep apnea. It is an overnight sleep test that monitors a participant’s biophysical changes that occur during sleep at a sleep laboratory. Many different sensors are attached to the participant’s body to measure brain waves (EEG), eye movements (EOG), muscle activity (EMG), heart rhythm (EC), oral and nasal airflow, blood oximetry, as well as audio during sleep. Besides its high cost and limited availability to many patients, the unfamiliar environment of the sleep laboratory as well as the equipment and sensors attached to the participant’s body can disturb the patient’s quality of sleep, thus leading to inaccurate test results. Therefore, there exists a need for a new inexpensive test that primary care physicians can use to accurately assess the pretest probability of the disease.

INNOVATION

Researchers at UCLA have designed a novel non-intrusive, remote health monitoring system for assessing sleep apnea. Studies have shown that OSA is associated with dysfunction in cardiovascular regulation of blood pressure and blood circulation. OSA patients’ heart rate responses are delayed and less pronounced compared to those of healthy people. This sleep apnea screening system aims at predicting the sleep apnea by triggering and observing cardiovascular responses in participants. This system consists of a mobile phone, a Bluetooth-enabled blood pressure monitor, a Bluetooth-enabled pulse oximeter and a Valsalva box. During the test, the Android application implementing a 20-minute protocol that guides users through a series of challenges that have been medically shown to trigger cardiovascular responses. Each challenge is preceded by a baseline period and followed by a recovery period for users to reach their normal resting blood pressure. Based on the user’s blood pressure, heart rate and blood oxygen saturation measurements that are collected by the application, advanced feature selection and machine learning algorithms are used to identify the user’s key contextual features and build effective prediction models that help identify OSA patient. The described OSA screening test does not require the user to be sleeping and it can be conveniently implemented in a familiar home environment without the need for specialized equipment or attendance of trained technique personnel.

APPLICATIONS

Obstructive sleep apnea (OSA) screening tool

ADVANTAGES

- Completely non-intrusive and requires no complex sensor attachments to the participant’s body
- Cost-efficient and affordable without the need for any specialized equipment or the attendance of technical personnel
- The short test can be performed at any time of the day and while the patient is awake
- The amount of data collected is significantly smaller than any other nocturnal test, which makes the post-processing and analysis of the data much faster and the data storage much easier
- Result is accurate and reliable for OSA screening

STATE OF DEVELOPMENT

The system has been tested in a pilot sleep apnea study of 16 patients and the results have demonstrated great potential in helping sleep specialists in the initial assessment of patients with suspected OSA.

RELATED MATERIALS

PATENT STATUS

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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Near-Realistic Sports Motion Analysis and Activity Monitoring
- A Device, Methodology And System For Monitoring, Classifying And Encouraging Activity
- An On-Bed Monitoring System For Rehabilitative Exercises