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An Approach to Analyze OSA Disorder by Integrating Bigdata with Cloud Algorithms

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ABSTRACT

Over the years, we human beings has been experiencing health changes in our lives. One of these changes are interruption in sleep. These changes are occurred in elderly people. To be particular, Obstructive Sleep Apnea (OSA) is one of the common and dangerous respiratory health disorder that occurs during sleep. It has a direct impact on the way of life. It is necessary to keep track of this disorder by live monitoring which we can accomplish by using Internet-Of-Things (IOT) and analyzing data is achieved by integrating Bigdata with cloud. It monitors elderly people with numerous factors such as sleep environment, sleep status, physical activities, and psychological parameters. It not only detects the OSA but also helps in treatment of OSA. The smart device sends notifications to the responsible care members of elderly people in emergency situations. Fog computing or edge computing approach is implemented on the device. The descriptive data analysis is done on the batch data that statically details the behavior of the data and predictive details for the development of services such as best places to perform outdoor activities. The whole processing uses big data tools on cloud computing. By using this we can easily identify the change in breathing in people who are suffering with OSA.

Keywords: Obstructive Sleep Apnea (OSA), Internet-Of-Things, Big Data, fog computing, big data tools, cloud computing.

1. Introduction

One of the most prevalent and harmful respiratory conditions that happens while you sleep is obstructive sleep apnea syndrome (OSA). OSA consists of the obstruction or partial blockage of the upper respiratory tract for at least 10 seconds and that prevents proper oxygenation of the blood, even over 20-30 times an hour of sleep. Based on number of interruptions per hour OSA is classified into three categories from higher to lower severity. Respiratory interruptions are classified as "mild" if they happen 5–15 times per hour, "moderate" if they happen 15–30 times per hour, and "severe" if they happen more than 30 times per hour.. There are many approaches available for OSA treatment, including weight loss, sleep hygiene techniques, positional and continuous open airway therapy (COAT), continuous positive airway pressure (CPAP) and surgical interventions. CPAP is an effective treatment for OSA, nevertheless adherence to treatment is suboptimal because to low perceived disease risk by the patients. This in turn may bring discomfort to the patients and lead them to interrupt therapy. This study proposes an architecture for an OSA monitoring system that uses Big Data and the Internet of Things (IoT). Fog and Cloud Computing capabilities are included into the three-layered architecture.

2. Literature Survey

In paper [1]. Explains Sleep Disorder Breathing(SDB) is a condition that ranges from primary snoring to obstructive sleep apnea. This article offers a detection evaluation methodology that may evaluate the similarity of two annotated respiratory-related events qualitatively. This protocol can be used in applications where an accurate estimation of the total number of events, their length, and their number and duration together are required. A data collection with approximately 10,000 manually annotated snoring occurrences from 9 patients is used to evaluate the application.

In paper [2]. explains obtrusive sleep apnea (OSA) is one of the most important sleep disorders because of it has a direct adverse impact on the quality of life. By monitoring a variety of elements, including the sleep environment, sleep status, physical activity, physiological measurements, and the utilisation of open data from smart cities, this research proposes a new approach for both detecting and supporting the treatment of OSA in senior individuals. In the event of an emergency, pre-processing based on rules permits the dispatch of real-time notifications to those in charge of caring for the elderly. A smart device running at the network's edge was used to implement a Fog Computing strategy in this pre-processing.

In paper [3]. explains the AES has been proven to be suitable for manual sleep staging and self-application in in-home polysomnography (PSG). The purpose of this study was to use an automated sleep staging method based on deep learning for EEG signals obtained using the AES. Convolutional and recurrent neural networks are used in the current neural network design, which has been demonstrated to produce high sleep scoring accuracy with a single common EEG channel (F4-M1). Based on EEG channels collected with the AES, the neural network in use was able to precisely identify different stages of sleep.

In paper [4]. Explains traditional sleep staging with non-overlapping 30- second epochs overlooks multiple sleep-wake transitions. This is addressed in this research by using deep learning techniques to examine the sleep architecture in greater depth and test the hypothesis that OSA patients' sleep fragmentation is underestimated by conventional sleep staging. To test this theory, we used overlapping 30-second epochs with durations of 15 seconds, 5 seconds, 1 second, or 0.5 seconds to identify sleep phases using deep learning-based sleep staging. In order to compare the variations in the sleep architecture between OSA severity groups, a dataset of 446 individuals who had been referred for polysomnography owing to OSA suspicion was employed.

In paper [5]. explains a frequent health problem that can have an impact on many facets of life is sleep difficulties. One of the most prevalent conditions, obstructive sleep apnea is characterised by a decrease or halt in airflow while sleeping. An costly test that requires a lot of patient effort, polysomnography is typically used in sleep laboratories to identify this disease. Multiple systems have been proposed to address this situation, including performing the examination and analysis in the patient’s home, using sensors to detect physiological signals that are automatically analyzed by algorithms. The objective of this study is to examine currently available algorithms that have not yet been implemented on hardware but have had their effectiveness validated by at least one experiment that tries to identify obstructive sleep apnea in order to show potential future trends.

3. Methodology

3.1 Using IOT predict OSA

Fig.3.1 shows the three functional layers—the IoT layer, the fog layer, and the cloud layer—that make up the proposed system's design. The various layers are combined in order to assist the OSA in diagnosing and treating elderly individuals inside of buildings like homes or hospitals in an effort to improve their quality of life. The IoT layer collects and combines data from several diverse sources before sending it to the fog layer. The system's fog layer offers the fundamental capabilities needed to ensure smooth communication and interoperability across the various heterogeneous devices involved. This layer is also in charge of pre-processing the sensor data required for identifying potential OSA-related adverse events in older persons and responding in real-time by alerting those in charge of providing for their medical needs so that they may get quick assistance. In order to find new information and hence improve medical decision-making, the data from the fog layer is saved, processed, and analysed at the cloud layer utilising general enablers offered by IoT platforms and algorithms based on Big Data. Finally, a graphical user interface (GUI) on a web application that transforms the collected data into rich material to direct OSA therapy allows the processing results to be shown.

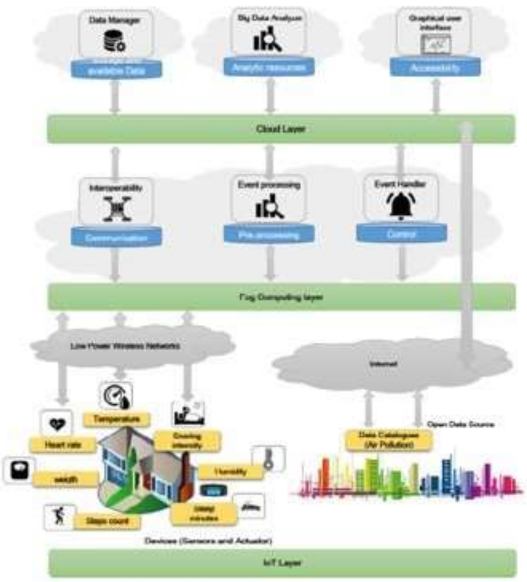

Fig 3.1: Functional layers of the system

3.2 Analysing data

Data from the fog layer and the open data catalogue accessible in smart cities may both be processed and analysed by Big Data Analyzer. As illustrated in Fig. 3.2.1, the analyser incorporates four modules to do this: data integration, batch processing, machine learning, and services.

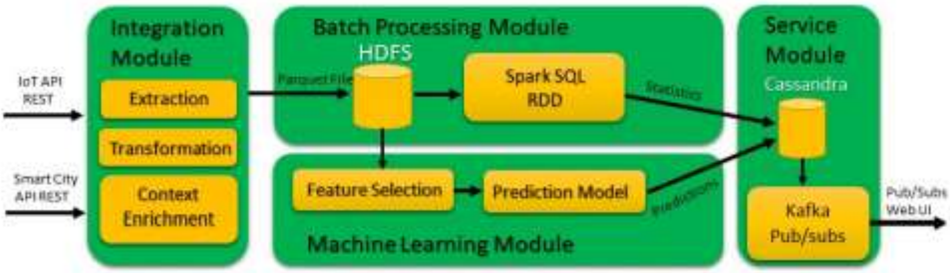

Fig.3.2.1: Big data analyzer architecture

4. Results and Discussion

The outcomes demonstrate how the system achieves its goal of identifying OSA episodes and assisting in their treatment. Two adult volunteers who struggle with falling asleep and/or have sleeping disorders were used in a number of trials. These volunteers' characteristics are listed in the tables below.

CHARACTERISTICS OF THE ADULTS VOLUNTEERS WHO PARTICIPATED IN THE EXPERIMENTS

	Volunteer A	Volunteer B
Gender	Female	Male
Age	65	60
Height	1.60 cm	1.65 cm
Weight	70 kg	62 kg
OSA Diagnostic	Yes (mild Apnea)	No (but he has problems getting to sleep)

Additionally, it is possible to see that the average temperature in the elderly person's bedroom is within the range of temperatures that are advised for those with these types of illnesses. This confirms that the actuators' settings are accurate enough to maintain a comfortable environment in the elderly person's bedroom.

When a monitored parameter surpasses the CEP-established thresholds, the system displays notifications on the smart mobile phone application in addition to the web user interface. Fig. depicts the notification of medical practitioners.

Fig: Web interface

5. Conclusion

Given that older adults will make up more than 14% of the global population in the future, QoL has developed into a requirement in society and will only grow more crucial. One of the illnesses that most seriously impairs the quality of life (QoL) of individuals who have it and leads to significant complications that can have a negative impact on their health is OSA. In order to improve adults' quality of life and, in certain situations, even save their lives, continuous monitoring and processing of several OSA-related indicators will enable prompt notification of medical personnel, emergency services, caretakers, and adult patients' family. A system based on a three-level architecture has been devised and put into place to facilitate real-time monitoring of OSA in senior patients and direct their therapy. The system is implemented with the help of a variety of discrete, non-intrusive devices, IoT protocols, elements of standard platforms, low-power technologies, big data technologies, fog and cloud computing strategies, and components of low-power technologies.

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