

DIAGNOSIS OF HYPERNYCHTHEMERAL SYNDROME USING MACHINE LEARNING

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ABSTRACT:

Hypernychthemeral syndrome is a disorder that affects normal 24-hour synchronization of circadian rhythms. The Circadian Rhythm is an internal biological clock situated in the brain of all living organisms. Circadian rhythms can influence sleep-wake cycles, hormone release, body temperature, heartbeat rate and other important bodily functions. Circadian rhythms are important in determining human sleep patterns. This disease occurs in blind people but can occur in normal people as well. The diagnosis and monitoring of this disease is done using a sleep diary that has to be maintained by the patients themselves which is a tedious task. Our approach is to use different sensors to analyse the environment condition, Sleep pattern, temperature, heart rate process the data by using k-means clustering and then classify them using the random forest algorithm to get the accurate prediction of this disease. Based on the output the warning is displayed to the patients through a web application as an alarm. This also helps to provide further monitoring of the disease based on the medication given to the patients.

Keywords: Hypernychthemeral syndrome, circadian rhythm, k-means, Random forest.

INTRODUCTION:

Hypernychthemeral syndrome, is a circadian rhythm sleep disorder characterized by non-synchronization to a 24-hour day leading to insomnia. This disorder mostly occurs in blind people but can occur in normal people as well. All life on earth has evolved in conditions of a 24-hour day-night cycle. The Disorder when untreated can lead to serious health problems like tumor, stroke, attack etc. Circadian cycle influence this disorder. Organisms have evolved mechanisms to time their cellular and metabolic processes to anticipate this daily rhythm. As a result, within nearly all cells of the human body there is a biological clock based on a cycle of DNA and protein synthesis. This biological clock is situated in the hypothalamus of the brain which is stimulated when sunlight passes through the individual's eyes and reaches the hypothalamus. As this is not possible in case of blind individuals it results in the irregular set-reset cycle of the circadian rhythm. While the total number of people living with this disorder is unknown, researchers assume that more blind people are affected than sighted people. It is estimated that 55-70% of all people who are totally blind have this disorder. The present day diagnosis of this disease is complicated. The patient has to record the sleep wake patterns and all the other physical parameters in a sleep diary for a few weeks which is a tedious task in case of blind individuals. The doctor then makes an analytic study on the sleep diary and then confirms this disease after a few biological tests. Our system provides a real-time monitoring of the disorder using sensors and then analytics is performed on the data sets using the k-means clustering and Random forest classification algorithm to predict whether the patient has hypernychthemeral or not. The hardware components of the proposed system has

synchronization to a 24-hour day leading to insomnia. This disorder mostly occurs in blind people but can occur in normal people as well. All life on earth has evolved in conditions of a 24-hour day-night cycle. The Disorder when untreated can lead to serious health problems like tumor, stroke, attack etc. Circadian cycle influence this disorder. Organisms have evolved mechanisms to time their cellular and metabolic processes to anticipate this daily rhythm. As a result, within nearly all cells of the human body there is a biological clock based on a cycle of DNA and protein synthesis. This biological clock is situated in the hypothalamus of the brain which is stimulated when sunlight passes through the individual's eyes and reaches the hypothalamus. As this is not possible in case of blind individuals it results in the irregular set-reset cycle of the circadian rhythm. While the total number of people living with this disorder is unknown, researchers assume that more blind people are affected than sighted people. It is estimated that 55-70% of all people who are totally blind have this disorder. The present day diagnosis of this disease is complicated. The patient has to record the sleep wake patterns and all the other physical parameters in a sleep diary for a few weeks which is a tedious task in case of blind individuals. The doctor then makes an analytic study on the sleep diary and then confirms this disease after a few biological tests. Our system provides a real-time monitoring of the disorder using sensors and then analytics is performed on the data sets using the k-means clustering and Random forest classification algorithm to predict whether the patient has hypernychthemeral or not. The hardware components of the proposed system has

Sensors
Arduino.

- Heart rate pcb
- LCD display monitor
- Software requirement within Software Engineering is a branch that establishes the requirements of stakeholders along with productive quality that can be done using softwares. The software requirement of the proposed system:
- R software
- Arduino programming software
- java
- Windows
- Shinyapps.io
- Cloud platform
- SQL database

OBJECTIVE:

The objective of our project is to ease the task of recording the activities of the patients and to predict whether the patient has the disease or not.

- Sensors are used to get the physical parameters and activities of the patients
- The data is stored in cloud and encrypted to avoid the intruders.
- The encrypted data is processed using k means clustering and classification to predict the disease
- The result is displayed in a web application.

RELATED WORK:

To diagnose the hypnnychthemeral syndrome, sensors such as temperature, heart rate and accelerometer are utilised. The temperature sensor detects the temperature of the patient, heart rate sensor is used to give the digital heartbeat when a finger is placed on it and accelerometer measures the acceleration by measuring the change in capacitance. Using these sensors, patient's real time data are acquired and with these data sets, the sleep status is concluded. Hypnnychthemeral syndrome can be diagnosed by attaching these sensors to the patient's body.

A similar investigation was proposed by Yunyoung Nam and Jinseok Lee, Sleep

disorders are a common affliction for many people even though sleep is one of the most important factors in maintaining good physiological and emotional health. Numerous researchers have proposed various approaches to monitor sleep, such as polysomnography and actigraphy. However, such approaches are costly and often require overnight treatment in clinics. With this in mind, the research presented here has emerged from the question: "Can data be easily collected and analyzed without causing discomfort to patients?" Therefore, the aim of this study is to provide a novel monitoring system for quantifying sleep quality. The data acquisition system is equipped with multimodal sensors, including a three-axis accelerometer and a pressure sensor. To identify sleep quality based on measured data, a novel algorithm, which uses numerous physiological parameters, was proposed. Such parameters include non-REM sleep time, the number of apneic episodes, and sleep durations for dominant poses.

According to Haitham M. Al-Angari and Alan V. Sahakian, Obstructive sleep apnea (OSA) is a common sleep disorder that causes pauses of breathing due to repetitive obstruction of the upper airways of the

respiratory system. The effect of this phenomenon can be observed in other physiological signals like the heart rate variability, oxygen saturation, and the respiratory effort signals. In this study, features from these signals were extracted from 50 control and 50 OSA patients from the Sleep Heart Health Study database and implemented for minute and subject clas

second-order polynomial kernels. For the minute classification, the respiratory features had the highest sensitivity while the oxygen saturation gave the highest

specificity. The polynomial kernel always had better performance and the highest accuracy of 82.4% (Sen: 69.9%, Spec: 91.4%) was achieved using the combined-feature classifier.

Similarly, B.Aeury recognised the Sleep apnea syndrome in the elderly. Sleep apnea syndrome (SAS) is a well established sleep disorder with high morbidity and mortality.

Patients are most often middle-aged men. SAS occurs in at least 1% of the adult population. Several studies have suggested that SAS is extremely frequent in the elderly, its prevalence ranging from 18 to 73% in this group. However, the generalization of these results to elderly cohorts is questionable because of several limitations of these studies, including lack of standard selection criteria, variation in recording techniques, the night to night variability of sleep apnea and the use of a moderate level of sleep disordered breathing (SDB) to define SAS (5 apneas per hour). The study best designed for valid extrapolation to the whole aged population estimates the frequency of SAS at 18%. However, most of these patients reported satisfactory sleep, and epidemiologic criteria for a causal association between SAS in the elderly and cardiovascular disease have not been satisfied. The conclusions of numerous studies dealing with impairment in cognitive function and SAS in the elderly are controversial. In fact, if the diagnostic threshold is increased from 5 apneas to 10 apneas plus hypopneas per hour, elderly SAS patients have more sleep disturbances, are more depressed and have cognitive deficits as compared to normal old persons. When an appropriate diagnostic index is used, SAS in the elderly resembles SAS described in the middle-aged population. In addition, a high apnea plus hypopnea index is an ominous predictor of mortality in the elderly population, and a very high level of SDB is an extremely significant risk factor for mortality during sleep phase in these patients. This review of the epidemiologic evidence suggests that only symptomatic elderly patients need to be recorded in a

sleep laboratory to diagnose and treat a sleep apnea syndrome. Epidemiologic studies including more numerous and more severely affected subjects are required to analyze the natural history of SDB in the elderly.

PROPOSED WORK:

In the proposed task, The multimodal Sensors connected through an arduino collects real time data from the patients

.These data are processed using machine learning algorithms -k-means classification and Random forest clustering .A sample set of historical data is used as the training set and a few test set of data is used.The real- time data collected from the sensors is added simultaneously to the test-data set.There is a web-application where the patients can view and monitor their live data and details.The output is displayed whether the patient has the disease or not and advices such as consult the doctor and take proper medication.

INPUT

Sleep Parameters Measurement:

Sleep is influenced by several factors that directly affect its quality, including the sleep environment and sleep state. The monitoring of these parameters will allow for the estimation of the presence of some type of alteration.

- **Sleep status:** frequent interruptions of deep sleep often lead to excessive sleepiness during the day and is a clear indicator that a person's circadian rhythm has greatly been affected. In this sense, motion sensors (an accelerometer and a gyroscope) are used to monitor the sleep quality based on the minutes of deep and light sleep of the elderly.

-**Steps count:** Steps have several advantages as a metric for assessing physical activity: they are intuitive, easy to measure, objective, and they represent a fundamental unit of human ambulatory activity. They have the added benefit of providing a valid assessment of sleep duration and quality.

Physiological Parameters Measurement:

Heart rate: this parameter has a strong link with strokes and heart attacks in people who have OSA because sleep disorders influence the autonomic nervous system and can cause heart rate disturbances. A heart rate monitor placed on the elderly's chest is used to monitor the heart rate during sleep, considering that 12:00 am to 06:00 am is the interval with a high risk of a heart attack.

Snoring intensity: Snoring is a major symptom of OSA and its intensity is closely correlated with the severity of this syndrome, that is, the intensity of snoring increases as OSA becomes more severe.

Therefore, it is necessary to detect snoring and assess its intensity. To do this, a 3-pin sound sensor module is used and located in the elderly person's room.

Physical Activity Parameters Measurement:

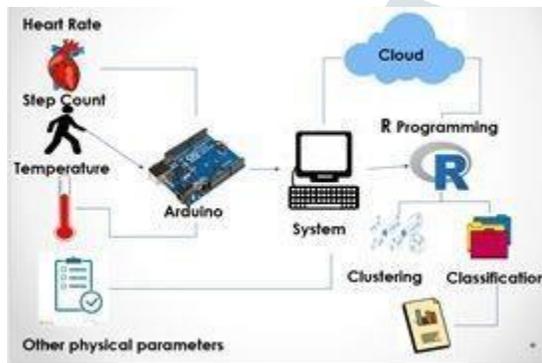
A healthy and active lifestyle is essential to mitigate the symptoms of OSA, this includes, among others, avoiding a sedentary lifestyle, performing physical activities, and maintaining a healthy weight.

Physical activity: Monitoring the physical activities in one's daily life can be beneficial to the health and individual sustainability of the person. For example, if a doctor has recommended a person to do exercises such as walking around the house, it is possible to control whether he complies with the care

plan. In this work, a pedometer embedded in an intelligent bangle is used to quantify the number of steps taken by the person during the day.

PROCESSING:

The IoT layer obtains and aggregates the data from multiple heterogeneous sources and transfers them to the fog layer. Fog layer provides the basic functionalities to offer seamless connectivity and interoperability between the different heterogeneous devices involved in the system.



This layer is also responsible for the pre-processing of the sensor data necessary for detecting possible adverse events for individuals relating to Hypnnycthemeral disorder and to react in real-time by sending notifications to those require immediate consultation from a doctor. The data from the fog layer is stored, processed, and analyzed at the cloud layer using generic enablers provided by IoT platforms and algorithms based on Machine Learning, in order to discover new knowledge and thus, support medical decision-making. Finally, the results of the processing can be visualized in a web application through a

THE RULES CONFIGURED IN THE COMPLEX EVENT PROCESSING

Parameters	Rules	Threshold	Monitoring interval	Actions
Steps count	sedentary	<5000	Daily	NHPC*
	mild active	5000-7499		
	moderate active	7500-9999		
	active	10000-12499		
	high active	>12500		
	Temperature	low temperature		
high temperature	>22 °C			
Humidity	low humidity	<50%	22:00 - 08:00	Dehumidifier NHPC*
	high humidity	>70%		
Heart rate	bradycardia	<50 bpm	22:00 - 08:00	NHPC*
	normal	60-100 bpm		
	tachycardia	>100 bpm		
Snoring Level	normal	<40 dB	22:00 - 08:00	NHPC*
	mild	40-50 dB		
	moderate	50-60 dB		
	severe	>60 dB		
BMI	underweight	<18,5 kg/m2	Daily	NHPC*
	normal	18,5-24,9 kg/m2		
	overweight	25-29,9 kg/m2		
	obese	>=30 kg/m2		

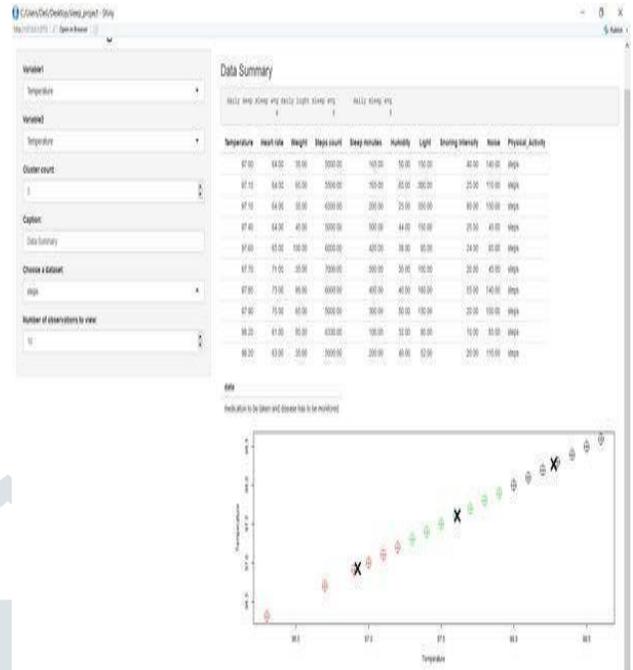
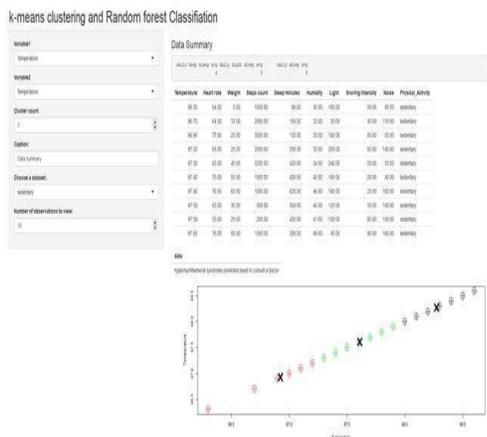
*NHPC: Notifications to health professionals and caregivers.

graphical user interface (GUI), which converts the analyzed information into rich content to guide the treatment of the Hypnnycthemeral disorder.

OUTPUT:

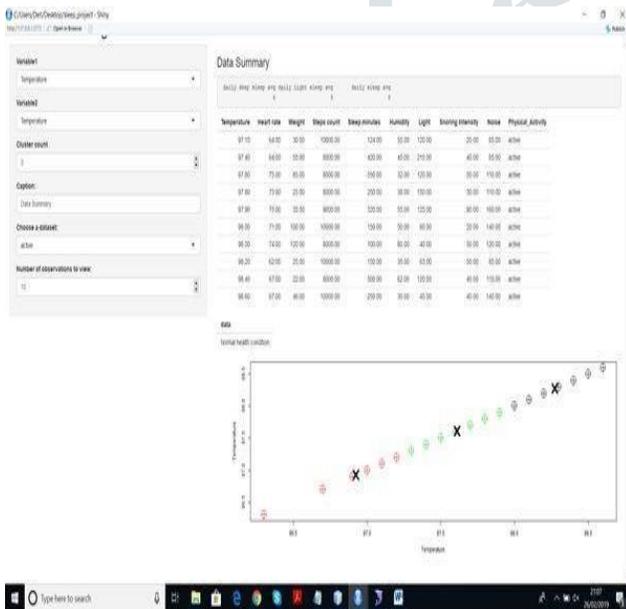
When the patient is diagnosed with the disease a warning is displayed to the patients through the web application. The patient gets advices whether he is healthy or need to consult a doctor immediately.

SCREENSHOTS: SEDENTARY



ACTIVE

CLOUD UI



SLEEP MONITORING

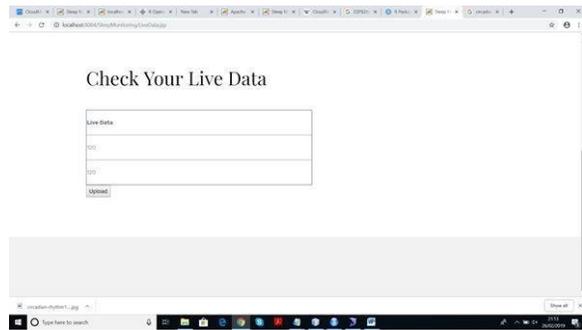
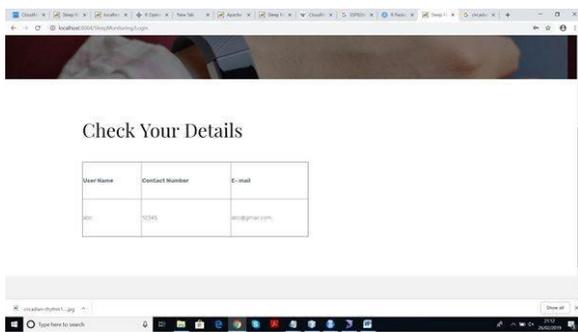
Diagnosis and monitoring of hypernycthemeral syndrome

LOGIN FORM

Name:

Email:

Password:



CONCLUSION:

The hypnycythemerl syndrome is usually misdiagnosed as other sleep disorders and the sleep monitoring process using the sleep diary method is very tedious for the patients..So to help the patients to keep track of the physical body parameters and know whether they have the disorder or not we make utilization of sensors to constantly screen and the data is used to perform analytics.This approach will act as an assistant to the patients to help in the monitoring and detection of hypnycythemerl syndrome.

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