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LOW-COST SYSTEM FOR THE RAPID DIAGNOSIS OF SLEEP APNEA, CAUSED BY THE COVID-19 PANDEMIC

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ABSTRACT

Sleep Apnea is one of the lesser-known pathologies that many people do not take into consideration when conducting a medical check-up, but it is one of the indicators of levels of fatigue, stress that are shown by lack of sleep, bad sleeping habits or other silent indicators such as problems breathing when sleeping, snoring among others. In these moments of confinement in our homes caused by COVID-19, where most of them cannot work, study or do other activities in person, certain levels of stress begin to emerge in both adults and children, these manifestations are shown in problems at bedtime. In the present work an analysis is carried out on the possible consequences of Sleep Apnea, as well as a methodology based on the use of Wearable Devices is presented, to be able to analyze how our way of sleeping is and thus be attentive to any changes in the demonstrations at bedtime. My methodology presents some previous steps for the configuration of the device, the

acquisition of information when we are sleeping and the analysis of the results of the signals captured at the time of sleep, the analysis is very intuitive. In this way we can know if we are changing habits when sleeping.

Introduction

In these moments of confinement, a product of COVID-19, all of us are being affected both directly and indirectly, one of the manifestations related to this confinement in our own homes is the appearance of certain symptoms such as sleep disorders, that can be caused by concerns regarding work in adults, in children also with regard to attending face-to-face classes, not being able to go out to play, among other common activities that are carried out [1]. Sleep problems also cause cardiovascular morbidity causing various clinical pictures, affecting 5% in adults and 2% in children, these manifestations are characterized by repetitive episodes of sleep withdrawal, in most cases they cause hypoxia. causing pathophysiological disorders [2]. Sleep apnea is being seen more frequently in children, the standard evaluation mechanism for these cases is the Polysomnographs, which allow the respective treatments [3]. One of the most important manifestations in Sleep Apnea is snoring, which by its quantity can be classified as apnea - obstructive hypopnea of the mirage, being serious if there is more than 30 snoring per hour [4]. Sleep apnea has its main characteristic the agony of breathing that lasts an average of 10 seconds or more, after having fallen asleep, this characteristic is more prevalent in people with excess weight, one of the most dangerous manifestations is when the airways are closed, causing daytime sleepiness, feeling drowning when asleep, recurrent waking up. [5]. The consequences regarding the work aspect of not being able to rest at night cause production levels to decrease considerably as well as cause health problems [6] [7]. With the indicated antecedents, it is important to be able to know and analyze our sleeping and resting habits, in order to carry out an early detection of the symptoms of Sleep Apnea, below is a methodology to detect these possible indicators of the levels of sleep, based on inexpensive devices known as Wearable devices.

Materials and methods

The methodology proposed in this work is related to how to use low-cost devices, which can measure and record certain variables that occur when a person is sleeping. The procedures to consider in the methodology are presented below.

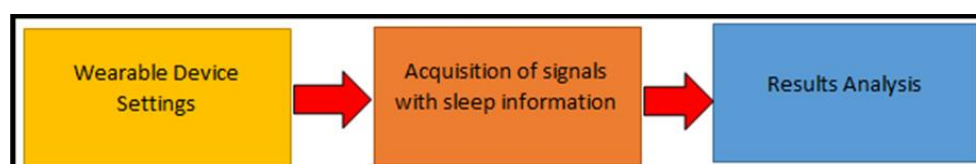


Figure 1. Block diagram of the proposed Methodology

Wearable Device Settings: The methodology presented is based on the use of wearable devices, which are presented as a watch. Where you can evaluate sleep states and sleep characteristics, for this, you must configure the device with the person's data as well as age and weight.

It is also required that the device application be configured on a cell phone and that it connects with the device, in this way all the data captured by the device is sent to the application for analysis and visualization.

Acquisition of signals with sleep information: The acquisition of the signals is carried out automatically, the device begins to work as soon as the person stops moving and understands that he is in a state of sleep and begins in the middle, the times, this analysis is carried out thanks to the gyroscope that the device has, which measures the movement of the person, with which it can be determined if he is moving or still.

Results Analysis: In the analysis stage, the person begins by verifying the values obtained by the device, verifying how their sleep rhythm is, with some times of deep sleep, light sleep and the average duration of sleep, mainly, all these values are evidenced in the application installed on the cell phone or tablet.

Results

The results that are presented are based on the analysis of the data that is recorded in the application that is connected to the device, for which it is evidenced that the data acquired in the moments that the person is sleeping, are presented in the device, this data can be displayed in daily, weekly, monthly and annual periods, for which the presentation mode must be selected.

For the methodology to be successful, it is necessary for the person to wear the device at all times, to ensure that the records are made constantly and periodically to have a good reading of the monthly and annual measurements..

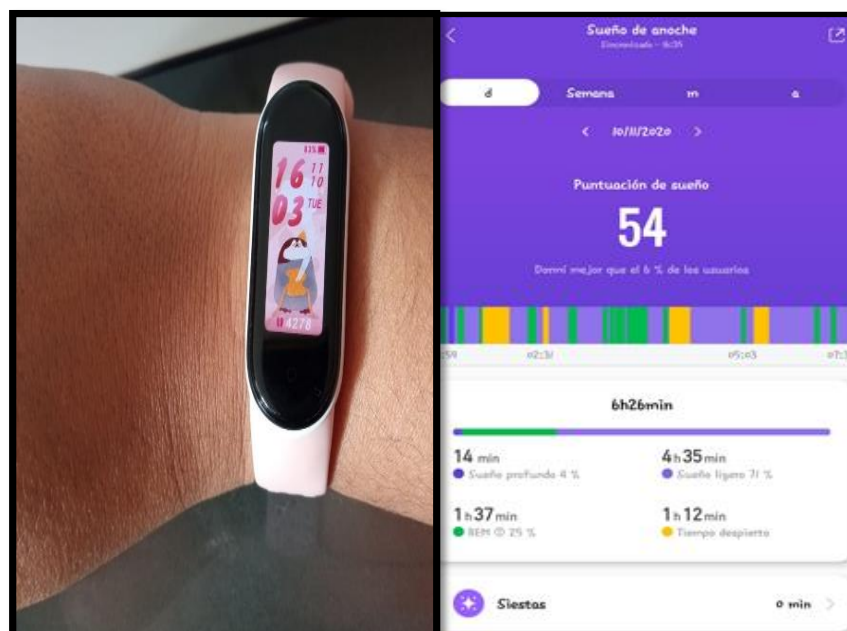


Figure 2. Use of the wearable device and its application installed on a cell phone

In figure 1, it can be seen that the person is wearing the device, as well as its respective application that is connected. In the application you can see the sleep score, which indicates a value from "0" to "100" where 100 is an average value of optimal sleep, a measurement of the time of deep sleep and light sleep respectively is also presented.

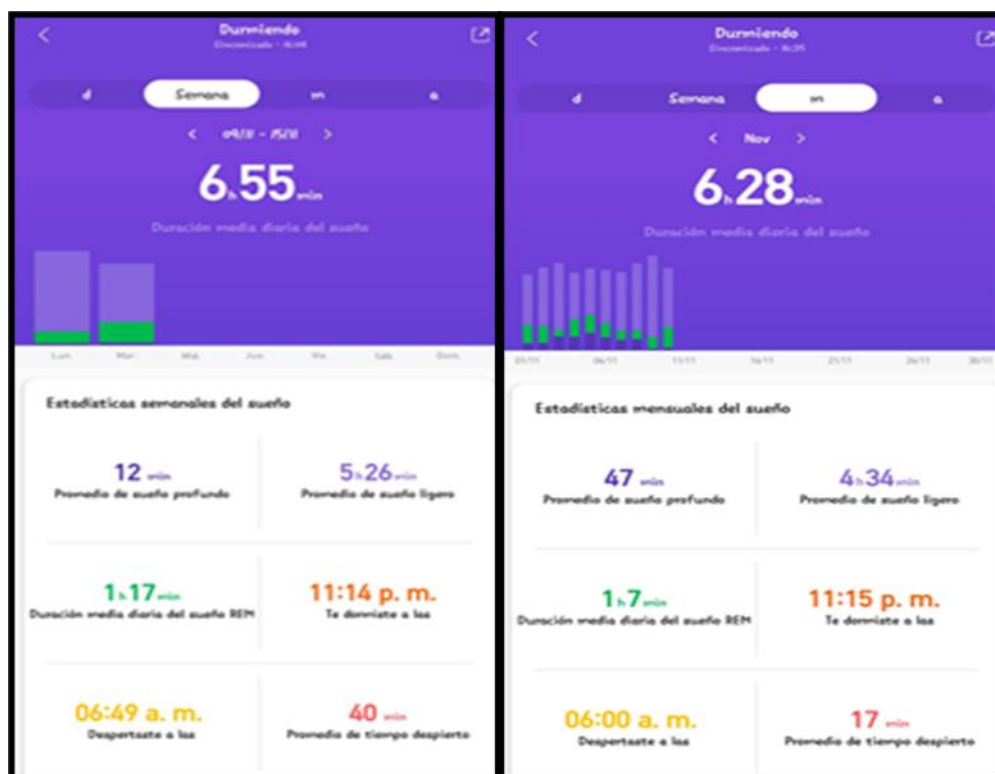


Figure 3. Statistics per week and per month of the mobile application

In figure 2, the results shown by the application are presented when the data is evaluated in weekly and monthly periods. Where you can also see average values of hours of light and deep sleep.

Without these data on the values of hours of both deep and light sleep, which must be taken into account to analyze if we are changing certain sleep habits, which can help describe and analyze some symptoms that correspond to sleep apnea. One of the indicators that can show in the decrease in hours of deep sleep, which would show that people, as a consequence of the pandemic produced by COVID-19, are suffering the consequences of mandatory isolation, which forces them to be at home without contact with other people, in most cases harming people at work.

A flow chart is presented below, where the steps to be taken are analyzed in order to show the changes in sleep factors.

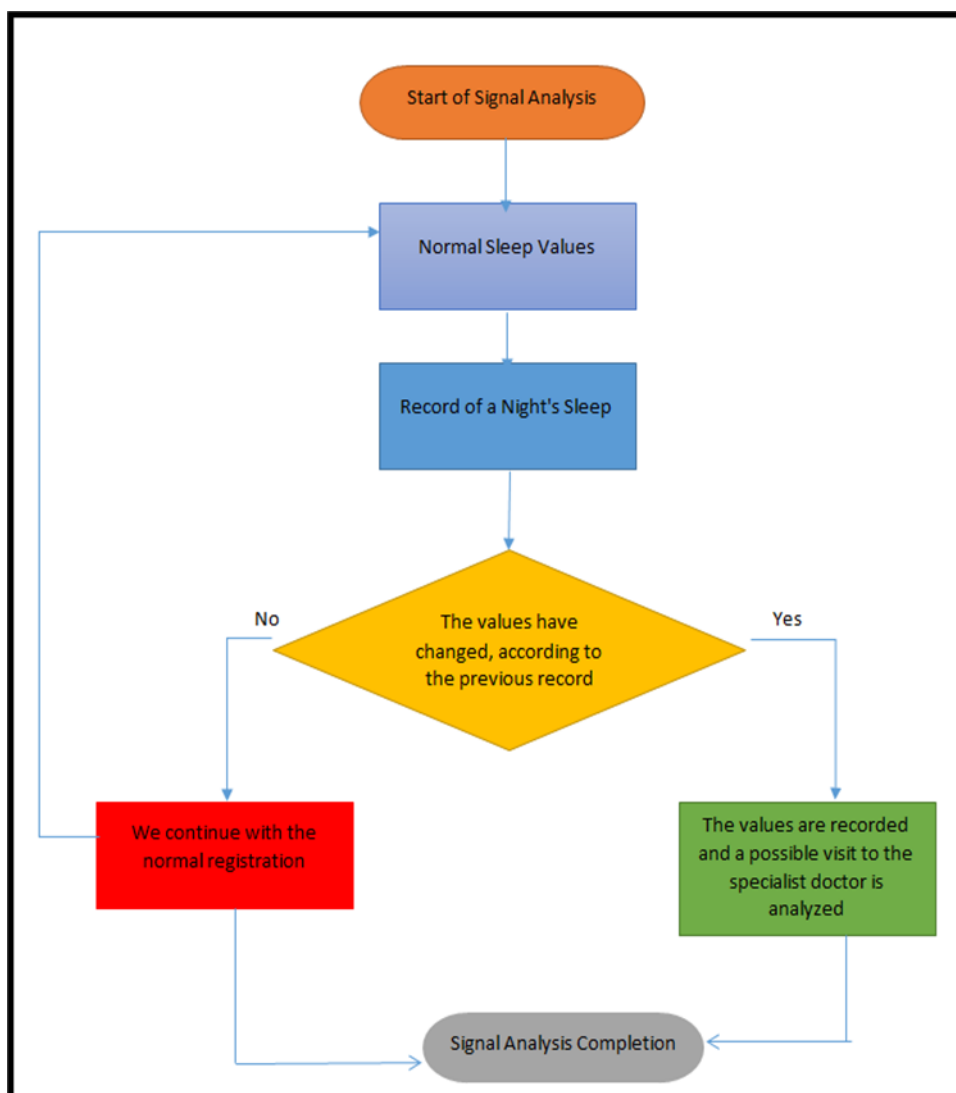


Figure 4. Algorithm for the recording and analysis of sleep values

In figure 4, the steps to be able to determine when changes in the sleep pattern can be evidenced are presented, being able to keep a control helps to determine certain changes that can trigger in the presence of Sleep Apnea.

Conclusions

At the end of the present investigation, it was concluded that the effects of COVID-19, is causing certain changes in the normal development of people's lives, which is mainly caused by the mandatory confinement that they are, which causes that cannot carry out the activities that they commonly carry out, affecting their work, educational, recreational activities among others.

One of the causes that are occurring is concern, and therefore one of the main symptoms is loss of sleep known as insomnia, but when these manifestations are occurring frequently, we may be facing a possible problem of Sleep Apnea . One of the standardized techniques to be able to diagnose is to undergo a medical evaluation, then through a team called a Polysomnographer, it can be diagnosed. But in this situation where most of the activities are carried out virtually, even medical consultations, it is

difficult to perform these tests. It is due to these characteristics that the proposal presents a practical and low-cost way, which can be done from home, which allows evaluating the presence of certain manifestations that may be the initial stages of Sleep Apnea, such as loss of sleep, decreased hours of deep sleep, interruptions in sleeping hours.

The proposed methodology is characterized by using wearable devices, capable of measuring the hours of sleep and being able to keep a record of all the manifestations that the person makes, with respect to the hours of rest, the analysis of these records can be evidenced in the mobile application, which these devices have and which can present in graphic form the average values of the hours of deep sleep, light sleep, hours of sleep, among others. The evaluation is carried out by the same people, with this they can identify these manifestations and at the time of a virtual medical appointment, they can comment to their doctor to have a better diagnosis.

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