How to improve consumer wearables for reliable home sleep monitoring

With an explosion in the offer and adoption of wearable monitors, together with the increasing awareness that sleep is a fundamental element in balanced living, it is inevitable that home sleep monitoring technology will reach widespread use in the next few years. However, evidence regarding the applicability of these devices is limited, and performance is modest. Researcher Pedro Fonseca has shown for the first time that the sensors used in modern consumer wearables, combined with methods he developed, can one day be used on patients suffering from sleep disorders, which can make the technology relevant for clinical practice.

Sleeping habits have changed throughout history following human progress and technological development. While we slept an average of nine hours per day in 1900, today we hardly get six and a half. To make matters worse, epidemic stress and obesity are contributing to the quick rise of insomnia and sleep apnea, with an important percentage of the population either suffering from a clinically relevant disorder, or simply reporting dissatisfaction with sleep.

The assessment of sleep disorders is traditionally performed in dedicated sleep laboratories, where trained technicians apply a multitude of sensors to monitor several physiological processes in so-called polysomnographic studies. However valuable, it has some limitations, such as the lack of applicability for more than one or two nights, or the fact that it is difficult to use in a home environment.

On the other hand, the recent and growing interest in sleep by the general public has led to an increasing demand and offer of sleep tracking devices which can be used without the assistance of a physician. These trackers have the potential to play an invaluable role in educating consumers on the importance of sleep and healthy sleep routines. However, they are based on a surrogate measure of sleep and most of their marketing claims lack proper validation or are outright implausible.

This may have seriously negative consequences for individuals with sleep-related concerns - but yet undiagnosed disorders - who will seek an explanation with these devices before consulting with medical professionals; or worse, for asymptomatic individuals with a hidden primary sleep disorder. Furthermore, the validation performance of consumer sleep tracking technology remains modest and the scarce evidence is mostly restricted to the analysis of healthy individuals.

This PhD research proved that in principle, these consumer wearables have sensors that could be used to more accurately monitor sleep at home. Although that might not be the case to date with the wearables on the market, future versions of these products could make use of the methods developed and described in the thesis (or equivalent) to achieve that purpose.

Furthermore, the research gave first evidence that in principle these methods are not limited to healthy subjects, which was the focus of the near majority of studies published to date. They can also possibly be used in subjects suffering from sleep disorders. The first evidence for this has been obtained in patients with sleep apnea; but further work needs to be done to ascertain its clinical value.

Home sleep monitoring technology will reach widespread use in the next few years, perhaps before it is even adopted and endorsed by medical sleep associations. It should change from a simple
monitoring and reporting tool to an instrument that can give users in general, and disordered patients in particular, actionable suggestions. This would provide the means to help the millions of people suffering from sleeping disorders or complaints.

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