New smart watch algorithms can help identify why you are sleeping poorly

October 15 2018

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New algorithms take advantage of multiple smart watch sensors to accurately monitor wearers' sleep patterns.

As well as obtaining rich information on wearers' sleep, the software, called SleepGuard, can estimate sleep quality and provide users with practical advice to help them get a better night's snooze.

SleepGuard tracks a combination of different non-biomedical factors—including body movements, sounds related to sleep disorders and ambient lighting.

Developed by researchers from Lancaster University in the UK and Northwest University in China, SleepGuard has been tested on 15 study participants. Results show that SleepGuard can estimate sleep-quality at a similar accuracy to consumer-grade sleep monitors. Crucially, it is also able to capture key information about the factors behind sleep quality and can help wearers identify the root causes of their poor sleep.

The research team hope the technology can help users to have a deeper and more comprehensive understanding of their sleep and enable them to take informed actions to improve the quality of their sleep and, as a result, their health.

Simple recommendations for getting improved sleep could involve altering the lighting in the bedroom, addressing noise, changing postures and also hand positions.

Dr. Zheng Wang, Senior Lecturer at Lancaster University and co-author of the research, said: "Sleep quality has been shown to depend on a wide range of factors, such as ambient light, noisiness as well as breathing patterns, sleeping postures and bedtime routines.

"Without details of the sleeping environment and the individual's postures and movements across sleeping stages, the root cause of poor sleep cannot be captured and therefore addressed.

Dr. Petteri Nurmi, Lecturer from Lancaster University and co-author of the work, said: "Our project aims to unlock the full potential of off-the-shelf consumer smartwatches, taking advantage of their sophisticated suite of sensors to gain a fuller understanding of a wearer's sleep patterns ."

SleepGuard captures physical activities rather than biomedical signals. It cannot be compared to the accuracy of medical grade technology, though its advantages are that it would be inexpensive to use and easy to use at home.

Researchers discovered that sleep quality is strongly linked to characteristics in body movements, health-related factors that can be detected through sounds and the sleeping environment itself.

Sensors within a smartwatch, such as the accelerometer, gyroscope and orientation sensor, were used to identify body and hand movements during sleep. The watch's microphone captures ambient noise, as well as wearer's snoring and talking during sleep. In addition a light sensor captures illumination in the sleeping environment.

SleepGuard is able to capture four basic sleep postures, such as sleeping on back, front and sides, as arm position is strongly linked to posture.

The technology is also able to recognise three common hand positions that can help identify sleeping issues. For example, placing a hand on the abdomen can indicate discomfort. Placing a hand on the chest can cause nightmares due to pressure on the heart, and placing a hand on the head can put excess pressure on shoulder nerves and cause arm pain due to restricted blood flow.

SleepGuard can also count the number of times the wearer rolls over during sleep—another indicator of sleep quality with excessive rollovers

potentially indicating disturbed sleep.

Dr. Liqiong Chang, Assistant Professor at Northwest University and co-author of the research said: "When compared to existing sleep monitors on the market, SleepGuard is able to report a wider range of sleep events and provide wearers with a better understanding for the causes of their sleep problems."

More information: Liqiong Chang et al, SleepGuard, *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* (2018). DOI: 10.1145/3264908 (PDF)

Provided by Lancaster University