Sleep pattern analysis based on data gathered by contactless sleep monitors

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I. INTRODUCTION
Sleep plays an important role in a healthy lifestyle together with nutrition and exercise. Many people suffer from insufficient sleep and sleep problems, and the incidence of insomnia has been increasing because of the busy nature of modern lifestyle. Polysomnography (PSG) is the gold standard method for accurate and objective sleep measurement, especially in the medical field. However, this method requires high intrusion and cost. Sleep condition is affected by various internal and external factors. The ideal quantity and quality of sleep depends on the individual and their health condition. In addition, improving sleep generally requires long-term treatment. In response, a sleep improvement supporting system has been designed, with a focus on its: ease of use, non-intrusion, low cost, and usage in daily life. It will realize monitoring longitudinal sleep condition in the home environment to recommend the most optimal and effective solution to improve their sleep. In this article, we developed contactless sleep monitoring device and sleep condition check service are introduced as well as the experimental results conducted.

II. DEVICE AND SERVICE

A. Contactless sleep monitor
The contactless sleep monitor employs radiofrequency waves to detect the body and respiration movements [1]. It communicates with ICT devices through either wired or wireless communication in order to send sensory data to a personal health record system named WellnessLink.

B. Sleep pattern classification program
The sleep pattern classification program extracts the following sleep problems by using sleep monitor data for two weeks [2].

A. Short time in bed
B. Trouble getting to sleep
C. Arousal during sleep
D. Early-morning awakening
E. Trouble with sleep rhythm

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III. RESULT

A. Device
In an attempt to see how effective the contactless sleep monitor is, we subjected adult sleep laboratory outpatients to simultaneous PSG and contactless sleep monitoring. The epoch-by-epoch accuracy on a per-subject basis was 84.1±11.1% (for sleep 91.8%, and wake 37.6%). According to Sleep/Wake conditions, the parameter Total Sleep Time (TST) average error was +12.7±63.9min, which was an overestimation of sleep time compared with the PSG method.

B. Service
The sleep pattern classification program found some interesting tendencies. In summary, males have more trouble falling to sleep compared to females (male 34.4%, female 23.7%), as well as having higher arousal during sleep (male 38.3%, female 20.0%). Among generations (age range), the differences were found in short time in bed (20’s 22.6%, 70’s 10.2%), arousal during sleep (20’s 34.7%, 70’s 42.4%), and trouble with sleep rhythm (20’s 96.8%, 70’s 79.7%).

IV. CONCLUSION
The contactless sleep monitor will allow the long-term assessment of sleep condition at home without any intrusion. The performance accuracy of the device has been proven, according to the comparison experiments performed. Additionally, sleep management programs could be developed by using the contactless sleep monitor. Some experiments were conducted to find the tendencies of sleep attributes and we discovered differences in sleep for both gender and generation groups.

This is just the beginning stage of serious studies to develop new indices of sleep conditions at home. Future work will find the association between sleep patterns and lifestyle habits to improve the sleep condition and quality of life.

REFERENCES