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Machine Learning-based Dynamic Activity Recommendation System

A deep learning architecture for wearable devices to evaluate, predict, and improve the quality of sleep by recommending personalized activities.

IP Status: Pending US Patent; **Application #:** 16/556,647

New deep learning architecture with predictive capabilities for wearable devices

While wearables, such as FitBit and other activity trackers, are useful for tracking and recording user's physical and sleep activities, annotation and effective interpretation of data requires expertise. Moreover, evaluation of longitudinal activity data is done only in retrospect. Recently, researchers at the University of Minnesota developed a data mining and machine learning approach to optimize a prediction framework, that anticipates sleep quality beforehand. By evaluating a person's physical activities over time, the algorithm recommends a set of activities to improve the quality of the individual's sleep.

Dynamic activity recommender to improve sleep behavior

Polysomnography (PSG) is the gold standard for clinical sleep diagnosis, and requires multiple sensors to track brain activity, body movement, heart rate, breathing frequency, and O2 levels. While PSG provides high-fidelity data, accuracy can be low because patients are required to sleep in the hospital, missing the more accurate picture of a patient's behavior in familiar settings. Wearables on the other hand, can track sleep and physical activities (actigraphy) around-the-clock in familiar settings. This recommender system was developed to evaluate actigraphy data of individuals using human activity recognition algorithms. After evaluation, the algorithm can identify behavioral patterns that lead to good or poor quality sleep. These patterns are then used as target behavior, to ensure a good night's sleep. This machine learning algorithm can be integrated with existing wearables to predict and recommend highly personalized behavioral changes to improve the individual's quality of sleep.

Phase of Development

Algorithm developed and validated in a small study. Currently under evaluation in a clinical trial with a larger patient population.

Benefits & Features

- Improved sleep outcome with personalized activity recommendations
- Predictive, rather than reactive analysis
- Sleep quality evaluated automatically using low-fidelity wearable devices
- Rich, all-day activity data produces better results compared to polysomnography
- Automated annotation of actigraphy data using machine learning

Applications

Technology ID
20180356

Category
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- Machine learning for actigraphy
- Cognitive behavioral therapy for treating insomnia

Researchers

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Publications

Computational Sleep Science: Machine Learning for the Detection, Diagnosis, and Treatment of Sleep Problems from Wearable Device Data
Ph.D. Dissertation (2017)

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