A Real-Time Technique for Early Prediction of Sepsis Using Wearable Devices

Dionisije Sopic, Tomas Teijeiro, Amir Aminifar, David Atienza

Swiss Federal Institute of Technology Lausanne (EPFL)
Lausanne, Switzerland

Background: The increasing prevalence of sepsis imposes a significant burden on hospital systems. Furthermore, the negative impact of sepsis on the patients' health, as well as the cost of treatment, is drastically increased as sepsis diagnosis is delayed. Remote wearable devices can potentially provide a low-cost, real-time solution for sepsis diagnosis and monitoring outside of the hospital environment. Moreover, they offer patient comfort and mobility without any impairments to the patients' daily routines. Thus, in this challenge, we focus on predicting the onset of sepsis using physiological parameters that can be acquired by means of wearable devices.

Methods: In order to meet limited power and memory requirements of wearable devices, we use a reduced set of available features. Namely, we consider the following vital signs: heart rate, pulse oximetry, temperature, systolic and diastolic blood pressure, mean arterial pressure, and respiration rate. Our algorithm uses a set of 84 features to predict a sepsis onset six hours in advance. The prediction is made by considering the aforementioned set of vital parameters extracted from the current hour, along with the history of the same vital parameters from the previous 11 hours. We use a random forest model with 100 weak learners because such a model has been demonstrated to be effective on low-power, low-memory wearable devices. Moreover, we use data augmentation techniques when no data is available to maximize the output of the utility score function.

Results: We have performed a 10–fold stratified cross-validation using the initial set of 5000 records. The overall utility score of our cross validation data is -0.00535. The next steps include the exploration of additional techniques that consider the temporal dynamics of the problem, such as, regression models, Markov chain, and Kalman filter.