SMART HEALTH

SEIZEIT: THE WEARABLE FOR PERSONALIZED SEIZURE DETECTION

Epilepsy is one of the most common neurological disorders, affecting 65 million people worldwide and costing around 30 billion euro each year. The correct logging of seizures is a critical part of any therapy decision. Despite its clear importance, there is no objective solution for outside of the hospital. Today, seizure logging is based on seizure diaries, kept by the patients themselves. Unfortunately, these manual seizure diaries are unreliable due to under-reporting; more than half of the seizures are not logged.

To log seizures in an objective way, there is a need for an automated seizure detection device, which records biomedical signals of the patient outside a hospital environment. Nowadays, the golden standard for recording epileptic seizures in the hospital is based on video-electroencephalography (EEG) with visual marking of seizures by trained physicians. However, this procedure is not suitable to apply for long-term monitoring in a home environment.

AUTOMATING SEIZURE DETECTION

SeizeIT is a multimodal, wearable, clinically-accurate seizure detection device. The prototype captures the majority of clinically meaningful seizures, in a socially-acceptable form factor (behind the ear). A few wearable epileptic seizure detection devices are already on the market, but these devices can only detect generalized tonic-clonic seizures (seizures accompanied with strong motions and increased muscle tension) when no other movement occurs, such as during sleep. Currently, no solution is available for seizures using other modalities than motion or muscle tension. In the context of SeizeIT, the project consortium aimed to develop a reliable, wearable, and comfortable seizure detection device for a majority of epilepsy seizure types.
Measuring EEG with a full set-up outside the hospital is unpractical. However, a few EEG channels can be captured using a wearable device. SeizeIT combines EEG with heart rate and movement. Depending on the seizure type and clinical symptoms during a seizure, different signals or a combination of them allow for accurate seizure detection. SeizeIT opted for a small behind-the-ear device that is worn like a hearing aid.

**SMALL BUT POWERFUL**

High-quality measurements are key for reliable seizure detection. The data acquired by the SeizeIT prototype closely resembles the data recorded with the standard hospital equipment. The seizure detection algorithm combines all 3 modalities in a way that allows for adaptation to each individual patient using only a limited amount of patient-specific data. It results in an overall sensitivity of 75% with 0.7 false detections per day, based on 25 patients including 109 seizures and 2593 hours of data.

SeizeIT is a multimodal system, allowing several biosignals to be measured simultaneously: behind-the-ear EEG, photoplethysmography (PPG, from which the heart rate can be extracted), and accelerometry (ACC). Additionally, small patch-based sensor modules can be placed on the body, to measure various biosignals (e.g. electrocardiography, accelerometry, electromyography, ...). The biosignals and body locations can be selected based on the patient’s seizure type. These biosensors can be easily incorporated in the SeizeIT system, which allows for further improvement of the accuracy of the seizure-detection algorithm.

**Key benefits:**

- Clinical-grade data: The first wearable that has received FDA/EMA approval.
- Long-term EEG in full synchronization with all other sensor modalities.
- Hardly visible and therefore socially acceptable. The device was co-developed with patients to ensure a socially-acceptable wearable.

SeizeIT started out as an imec.icon research project (2016-2018), and currently continues as an EIT Health funded initiative (2019-2021). The imec.icon research program equals demand-driven, cooperative research. The driving force behind imec.icon projects are multidisciplinary teams of imec researchers, industry partners and/or social-profit organizations. Together, they lay the foundation of digital solutions which find their way into the product portfolios of the participating partners.