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HEALTH

SeizeIT

An unobtrusive wearable logger for epileptic seizures

Epilepsy is one of the most common neurological disorders, affecting 65 million people worldwide and costing around 30 billion euro each year. Anti-epileptic drugs provide only adequate treatment for about 70% of epilepsy patients. 30% of the patients remain to have seizures, which seriously decreases the patient safety and quality of life. Furthermore, an average of 1000 people die every year due to epileptic seizures.

The correct logging of seizures is a critical part to analyze the current patient need. It is also important for the evaluation of antiepileptic drugs. Today, seizure logging is based on seizure diaries, kept by the patients themselves. Unfortunately, these seizure diaries are shown to be unreliable due to under-reporting; more than half of the seizures are not reported in these manual seizure diaries.

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. Based on these signals, a computer-based algorithm can be used to automatically detect the seizures. With this information, an electronic diary can be generated.

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..

Measuring EEG with a full set-up outside the hospital is too cumbersome and stigmatizing. However, a few EEG channels can be recorded with a wearable device. Besides the EEG data, other biomedical signals (heart rate, movement, muscle tension, ...) are of interest for seizure detection.

Depending on the seizure type and clinical symptoms during a seizure, different signals or a combination of them are useful.

A few wearable epileptic seizure detection devices are already on the market. Most of those devices however focus on tonic-clonic seizures accompanied with strong motions and increased muscle tension (Embrace Smartwatch, Nightwatch, Brain Sentinel). Currently, no solution is available for seizures without muscle motion or tension.

In the context of SeizeIT, the project consortium aimed to develop a reliable, wearable, and comfortable seizure detection device for all types of epilepsy. The device measures simultaneously a few EEG channels, heart rate and movement, which are fused in a multimodal seizure detection system.

The device should be worn continuously day and night, so it's important to have a wearable, comfortable, and concealable device. On the other hand, high-quality measurements are needed to provide a reliable seizure detection.

THE OUTCOMES

1. A wearable and unobtrusive device

The SeizeIT partners Pilipili and Byteflies succeeded in shaping the wearable seizure detection device similar to a hearing aid device, worn behind both ears. The design is co-created with input from epilepsy patients themselves in order to assure high comfort for the patients during usage.

2. High data quality

SeizeIT is a multimodal system, allowing several biosignals to be measured simultaneously: behind-the-ear EEG, Phytoloplethysmography (PPG), from which the heart rate can be extracted, and accelerometry (ACC).

Additionally, small sensor modules (see figure on the right), which can measure various biosignals (e.g. electrocardiography, accelerometry, electromyography, ...), can be placed on the body. The measured biosignals and body location can be selected based on the patient's seizure type. These small sensors can be easily incorporated in the SeizeIT system, which allows to further optimize the accuracy of the seizure-detection algorithm.

It has been shown that the acquired data from the wearable device closely resembles the data recorded with the standard hospital equipment with close to perfect similarity.

3. An effective algorithm to highlight possible seizures for neurologist

STADIUS, an imec research group at KU Leuven, developed an interpretable seizure-detection algorithm using behind-the-ear EEG and heart rate. Information from both modalities is combined in a flexible way, which allows to adapt fast to each individual patient with a limited amount of patient data. An overall sensitivity of 75% was obtained with 0.7 false alarms per day, tested on 25 patients including 109 seizures and 2593 hours of data.

NEXT STEPS

The prototype will be further developed by the SeizeIT partners and some new partners within an EIT Health innovation project grant. It is anticipated that the prototype could be available on the market by 2020 Q2, with medical certification by early 2022.

In a first stage, the seizure detection device will be used for evaluation of new anti-epileptic drugs in clinical trials, and it will work in offline modus. Next, it will be able to measure data in real-time and send an alarm to a computer or smartphone. It is postulated that the device could also be used for seizure prediction, and eventually be used in a kind of closed-loop system with a neuroprobe to even prevent seizures from happening in the future.

SeizeIT project partners:

Byteflies pilipili ucb KU LEUVEN UZ LEUVEN

FACTS

NAME	SeizeIT
OBJECTIVE	A wearable seizure detection device aiming to give epilepsy patients more control over their daily lives.
TECHNOLOGIES USED	Wearables, signal processing, machine learning
TYPE	imec.icon project
DURATION	01/10/2016 – 31/12/2018
PROJECT LEAD	Gergely Vertes, UCB
RESEARCH LEAD	Borbála Hunyadi, STADIUS, an imec research group at KU Leuven
BUDGET	1.735.850 euro
PROJECT PARTNERS	Byteflies, Pilipili Productdesign N.V, UCB
RESEARCH PARTNERS	KU Leuven - Faculty of Medicine
RESEARCH GROUPS	STADIUS, an imec research group at KU Leuven

WHAT IS AN

IMEC.ICON PROJECT?

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.

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AGENTSCHAP INNOVEREN & ONDERNEMEN Vlaanderen is ondernemen

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