**BACKGROUND**

Ambulatory seizure detection could provide timely alarms, peace of mind, and help to reduce severe outcomes for those with epilepsy. An initial hospital-based pilot study to explore the feasibility of a long-term remote study is currently being carried out. The platform collects wearable sensor data recorded concurrently with video-EEG and processes it for study administrators, clinicians, and data scientists to create seizure detection models.

**AIMS & OBJECTIVES**

The first application of the RADAR-base platform is a multicenter epilepsy wearable monitoring study, looking to recruit 200 patients across two sites, with a 5-7 day typical recording period. The aims of the study are to:

- A real-world test of the RADAR-base platform.
- Develop a seizure detection algorithm(s) for a variety of seizure types.
- Assess the suitability of devices for a follow-up ambulatory study.

**RESULTS AND VISION**

The presented set-up has been successfully tested in an ongoing clinical trial at the video-EEG monitoring units of both King’s College Hospital, London and the University Hospital of Freiburg. So far 135 patients have been enrolled across both sites.

We are investigating the potential of wearable devices as clinically valuable alternatives to complement hospital-based technologies, and as a prerequisite to future ambulatory passive remote monitoring of patients in their home environment.

The capabilities of the RADAR-base platform are sufficient for an in-hospital study of patients with epileptic seizures, and a further study in an ambulatory setting is expected to use the platform in a similar manner.

**HOW IT WORKS**

RADAR-base platform collects data synchronously to the video-EEG setup. The requirements fulfilled by the data collection apparatus are:

1. Integration of several different wearable device types for separate concurrent data collection.
2. Capability to stream the device data in real-time, with no patient interaction.
3. Easy management of the involved devices for patients and study staff.
4. Synchronisation of the wearable sensor data with the video-EEG to an accuracy of ~1/10 second.

The wearable devices connect via Bluetooth to an Android application, which synchronises its time with an NTP server shared with the video/EEG computers, and uploads the data to the RADAR-base platform. A mobile application that directly pairs to a wearable device alleviates the need for patient-managed data uploading and can provide clinicians with real-time information.

Devices were chosen that had sensors able to monitor physiologically relevant signals to provide multimodal detection, movement by accelerometry, electrodermal activity or heart rate by ECG/PPG, for example. They include the Empatica E4 and Biovision VSM, shown in Figure 1 on the wrist and upper arm respectively.

**FUTURE WORK**

- Build multimodal detection models on the current data for multiple seizure types
- To begin we will follow an analytical pipeline comparable to similar studies; feature extraction followed by a standard machine learning classifier. Fine-grained expert labelling will allow us to subsequently investigate multi-label classification on the symptoms/stages of a seizure.
- Determine most promising device for a follow-up ambulatory study. The device must balance:
  - Patient usability and comfort
  - Seizure detection accuracy

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