The RADAR platform: an open source generalised mHealth infrastructure

**THE RADAR-CNS PROJECT**

The £2m IMI2 Remote Assessment of Disease and Relapse - Central Nervous System (RADAR-CNS; http://radar-cns.org) initiative is a new research programme aimed at developing novel methods and infrastructure for monitoring major depressive disorder, epilepsy, and multiple sclerosis using wearable devices and smartphone technologies. While a number of commercial mHealth solutions are available to aggregate sensor data, there is a lack of an open source software stack that provides end-to-end data collection functionality for research, clinical trials and real-world applications. The RADAR platform aims to fill this gap, providing a generalised, scalable, fault tolerant, high-throughput, low-latency data collection solution.

**AIMS**

By leveraging open source data streaming technologies, an end-to-end system was built with generalised data aggregation capabilities. The platform will focus on classes of data rather than specific devices, in doing so it will enhance modularity and adaptability as new devices become available. The platform is delivered under an Apache 2 open source licence in order to create a legacy for downstream RADAR projects and the wider mHealth community. The key components of our software stack include: Data Ingestion and Schematisation (using Apache Avro), Database Storage and Data Interface, Data Analytics, Front-end Ecosystem, Privacy and Security.

**HOW IT WORKS**

The Confluent Platform is a key component in the data pipeline architecture, this open source suite of streaming tools is built around Apache Kafka. Patient data is collected from passive (e.g. hardware sensor streams) and active (e.g. questionnaires, digital apps) data sources. These data payloads are then ingested via an HTIPS interface which translates REST calls into native Kafka calls. After a restructuring phase, data are simultaneously analysed and persisted. Two different data warehouse layers (cold and hot storage) are deployed to provide low latency and high performance data access via controlled interfaces. RADAR-CNS Platform runs on Docker to obtain extremely light and easy to deploy infrastructure.

**EPILEPSY, DEPRESSION & MULTIPLE SCLEROSIS STUDY**

- Epilepsy patients are undergoing study at KCL and Freiburg.
- Depressions patients are enrolled and undergoing study at KCL.
- 200 patients will be enrolled for Epilepsy study 1.
- 600 patients will be enrolled for the depression study.
- Multiple Sclerosis study will target 640 patients.
- Other IMI studies using the platform:
  - Alzheimer’s study is envisioned with RADAR AD platform.
  - BigData@Heart.

**RESULTS AND VISION**

The catalogue of currently integrated devices include on-board Android smartphone sensors along with Empatica E4 Wristband, Pebble 2 Smartwatch, Biowotion VSM, Faros 180, Fitbit devices. Capability is provided to integrate all wearable devices offering a native SIM to passively collect RAW data or through a vendor REST API data access. Beside the pRMT app (passive data source), a questionnaire app built with Cordova (eRMT) offers an active remote monitoring data source which can render questionnaires from a simple JSON configuration file.

RADAR-CNS aims to stimulate the field of mHealth by providing an off-the-shelf platform for general data collection. The project has long term goals to improve patient care by predicting and pre-empting relapses with the use of remote assessment technologies in a wide variety of disorder areas.

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