Collecting and analysing data from wearable devices to monitor symptoms of Parkinson’s disease

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Parkinson’s disease

- Neurodegenerative disease
- Affects 1% of population over the age of 65
- Motor and non-motor symptoms
- No existing cure
- Some medication can alleviate the symptoms

Figure 1: Parkinson’s disease affected brain shows lower levels of dopamine in PET scan, in red. (photo by Marc Savasta, INSERM Grenoble)
My summer project

Developer for the Kuranos Parkinson Project at CERN, which aims to provide effective monitoring of Parkinson Symptoms.

Four main goals:

- Create an Apple Watch application to acquire motion and health data
- Store the centralized data using the CERN EOS disk storage system
- Create a dashboard where symptoms can be monitored
- Perform preliminary analysis using existing datasets
Architecture and technologies

**Figure 2**: The designed architecture and used technologies
Results - Data acquisition (1/3)

Developed an Apple Watch application using SwiftUI

Collected data include:

- Acceleration, orientation of the watch;
- Heart rate, Blood oxygen saturation, etc.
- Step count, walking speed, walking asymmetry percentage, stair ascent speed, etc.
- User-entered information: medicine intake, tremor rating, etc.

Figure 3: The symptom rating page of the Apple Watch application
Results - Data acquisition (2/3)

**Figure 4:** The main page of the iPhone companion application

**Figure 5:** Dynamic notifications on the Apple Watch to remind users to take their medicine
Results - Data acquisition (3/3)

Developed a Django server to receive collected data and store it on EOS in the HDF5 format.

**Figure 6:** Example of a REST API endpoint of the web server
Developed a Django website for data monitoring and visualisation.

**Figure 7:** The main page of the Kuranos Parkinson dashboard
Figure 8: Example of collected heart rate from a test subject (in beats per minute)
Figure 9: Example of collected accelerometer data from a test subject
Results - Data analysis

Created notebooks and pipelines for data analysis

- Fourier-based band pass filtering
- Time series feature extraction using *tsfresh*
- Random Forest Classifiers using *scikit-learn*
- Deep Neural Networks using *PyTorch*

![Figure 10: The effect of band pass filtering, used to keep frequencies associated with the rest tremor](image)
Conclusions

- The Kuranos Parkinson Project aims to provide a solution to monitor symptoms of Parkinson’s disease using wearable devices.
- Built full chain from data acquisition though upload and storage to visualization and analysis.
- Provides functional basis for further development towards wider patient tests.

https://kuranos.web.cern.ch/