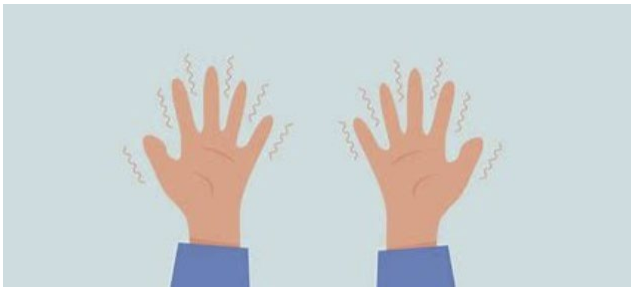
Embedded Challenge Fall 2025
Term Project
“Shake, Rattle, and Roll..and Freeze”

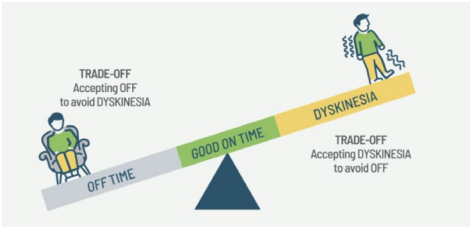


Objective:

- Use the data collected from a single accelerometer and gyroscope on your dev board to detect tremors or dyskinetic hand movements as well as a “freezing gait” condition, as exists in patients with Parkinson’s disease. Use the integrated BLE radio to transmit information on all three conditions to your mobile device on three different BLE characteristics on a single service.

Motivation:

- One of the primary symptoms of Parkinson’s disease is tremors in a dominant arm. Tremors are defined as rhythmic oscillations in the frequency range of 3-5Hz. The treatment for these tremors is typically a dopamine boost, which transitions the patient from the “Off” state to the “On” state. However, if too much dopamine is provided, an additional symptom call dyskinesia occurs. This is characterized by rhythmic dance-like movements in the frequency range of 5-7Hz. It is essential to have this information to properly medicate a patient so that the patient is “On”, but not too “On”. In addition, late stage patients also experience “freezing gait” episodes. This is characterized by a sudden freezing of the body, after a period of walking (detected using step detection, cadence etc.) These episodes often result in an emergency room visit….



Credit:www.gocovri.com

Characteristics:

- Your development board integrates an accelerometer/gyro capable of detecting acceleration and/or rotation in three directions. It is capable of acquiring data at the required rate (52Hz) and the required resolution (+-2G) to detect both movement conditions and the required measurements for “gait freezing”.
- You should design your system to capture 3 second intervals of data that you can process using an FFT library to return information on frequency distribution of the data in the 3 second interval. You can research what FFT library and how to use that library. In general, all will work the same way. You will provide an array of data and a sampling frequency. It will then provide back the frequency content of the data. We will discuss further in class.
- You should only use the development board resources to creatively control and indicate if either of these conditions exist as well as the intensity levels. This includes buttons, LEDs, a BLE radio etc…
- You can power your device with a simple power bank.
- Only your controller dev board can be used. No additional hardware.
- Only PlatformIO may be used.
- You will submit your PlatformIO project directory as a deliverable.
- You will prepare and submit a 1 minute video demonstration/explanation of your device functioning.

Grading Criteria:

- Ability to successfully detect tremors (20%)
- Ability to successfully detect dyskinesia (20%)
- Ability to successfully detect FOG (20%)
- Repeatability and robustness of detection (via video demo) (10%)
- Ease of use (10%)
- Creativity (10%)
- Well written code (5%)
- Complexity (5%)