

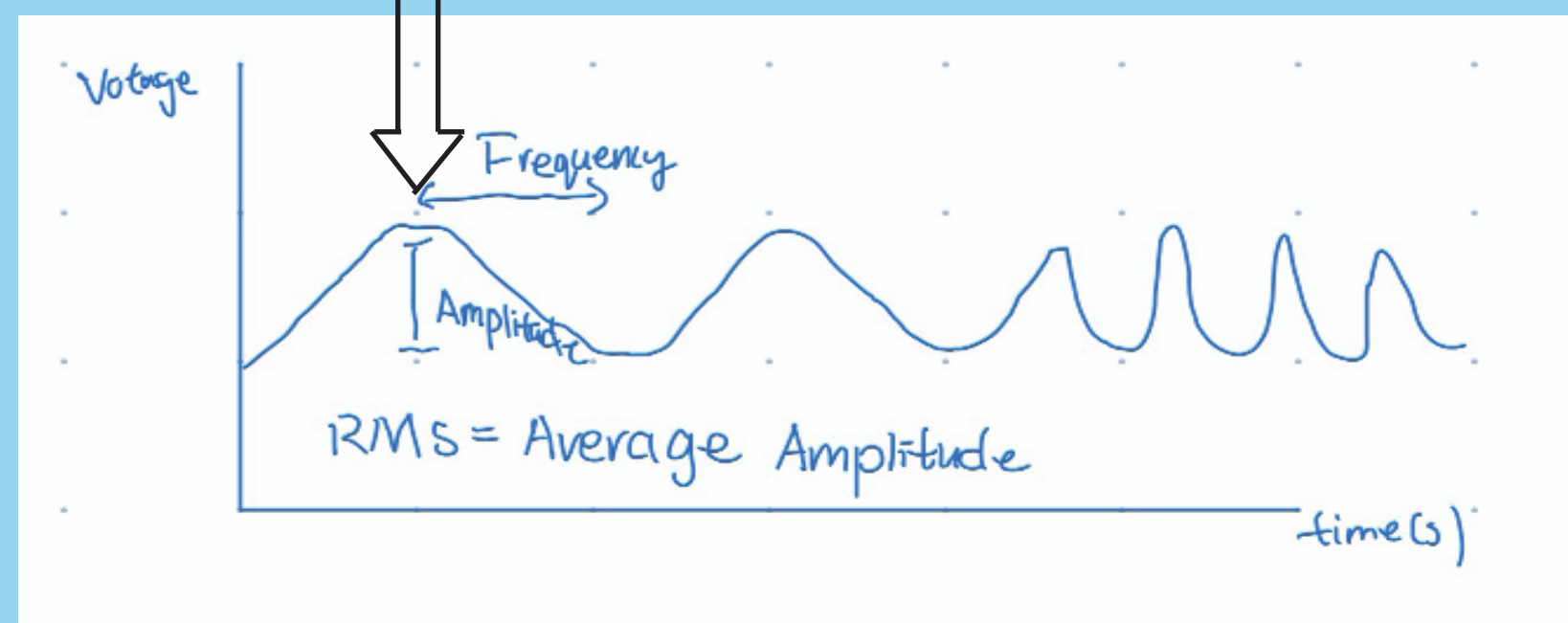
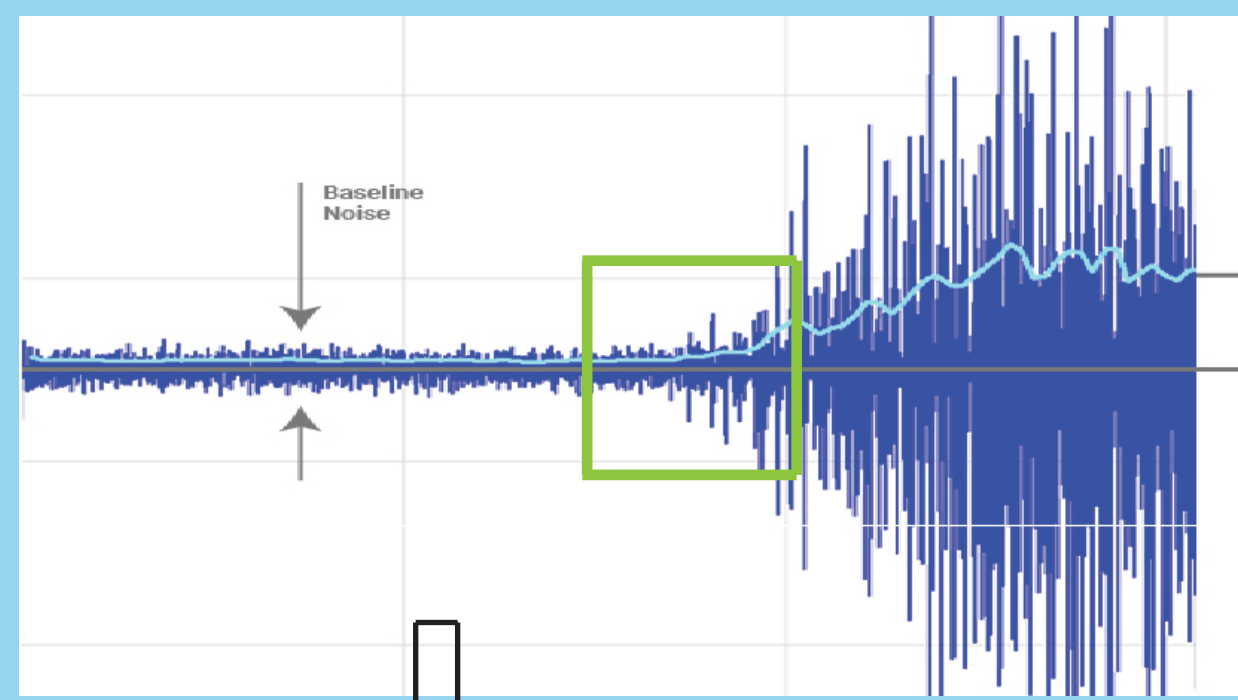
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Project Statement

Millions of people globally experience symptoms of tendonitis each year. People with tendonitis in rehabilitation need a way to detect real-time muscle fatigue in repetitive exercise to prevent reinjury. We developed a low cost, portable EMG based on the Arduino platform. Software analysis of the EMG signal will allow users to be alerted when the muscle is fatigued to let them pause for recovery.

Background: EMG

A raw EMG signal is shown as a complicated sine wave. In order to understand the complicated wave we obtain quantitative information by dissecting the wave into amplitude and frequency using RMS and FFT calculations. (Amplitude shows how tall each wave is and frequency shows how wide). The connection between the muscle fatigue and amplitude & frequency of muscle EMG signal is shown in prior research.

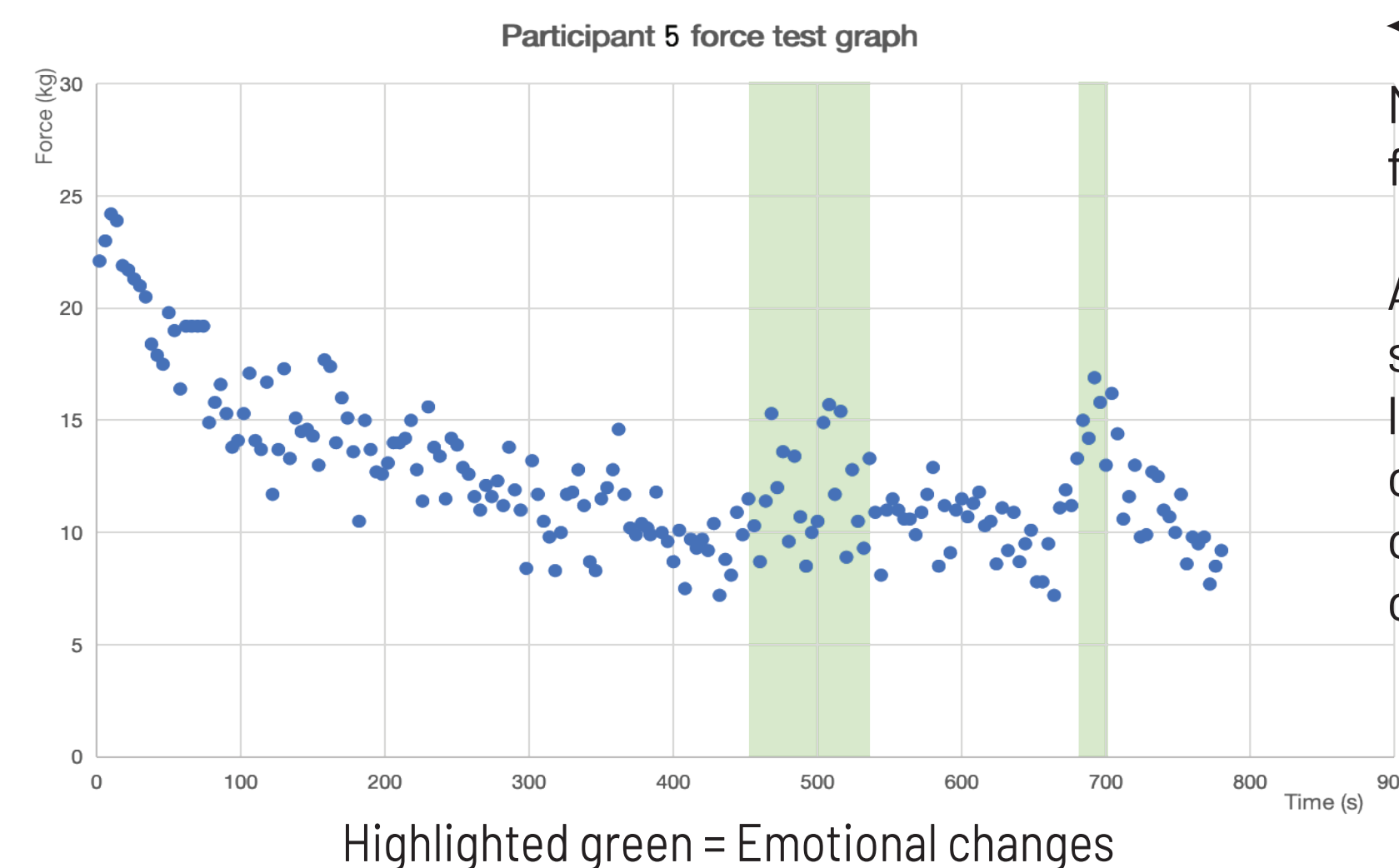


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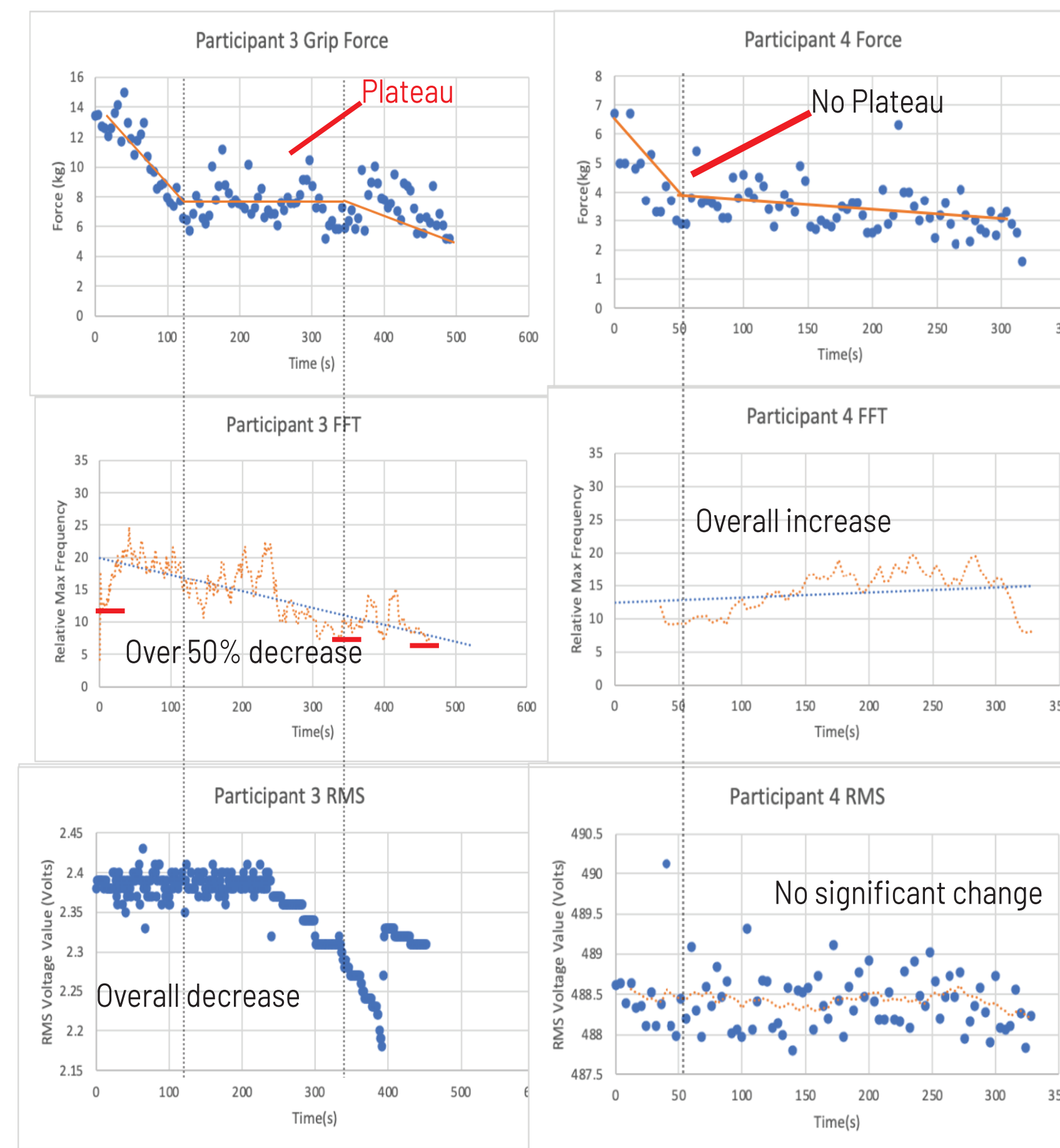
Muscle Fatigue can be detected using EMG

Most participants shows the same pattern of the force graph as participant 3. The start of the second decline corresponds to a 50% drop in maximum frequency (which is consistent with the 44% drop described by Fuglevand et al., 1999). Based on the correlation of these two events, we suggest the start of the second force decline is a potential indicator of muscle fatigue. The atypical subject participant 4 does not show the same force trend. In this case, we believe the plateau is too short to be identifiable. If we assume the subject's second decline starts at the end of the first decline, the inflection point correlates with the maximum frequency drop predicted. A short plateau is consistent with observations of the participant during testing, who seemed to reach fatigue quickly.

Decreasing Frequency and Increasing Amplitude indicates fatigue →



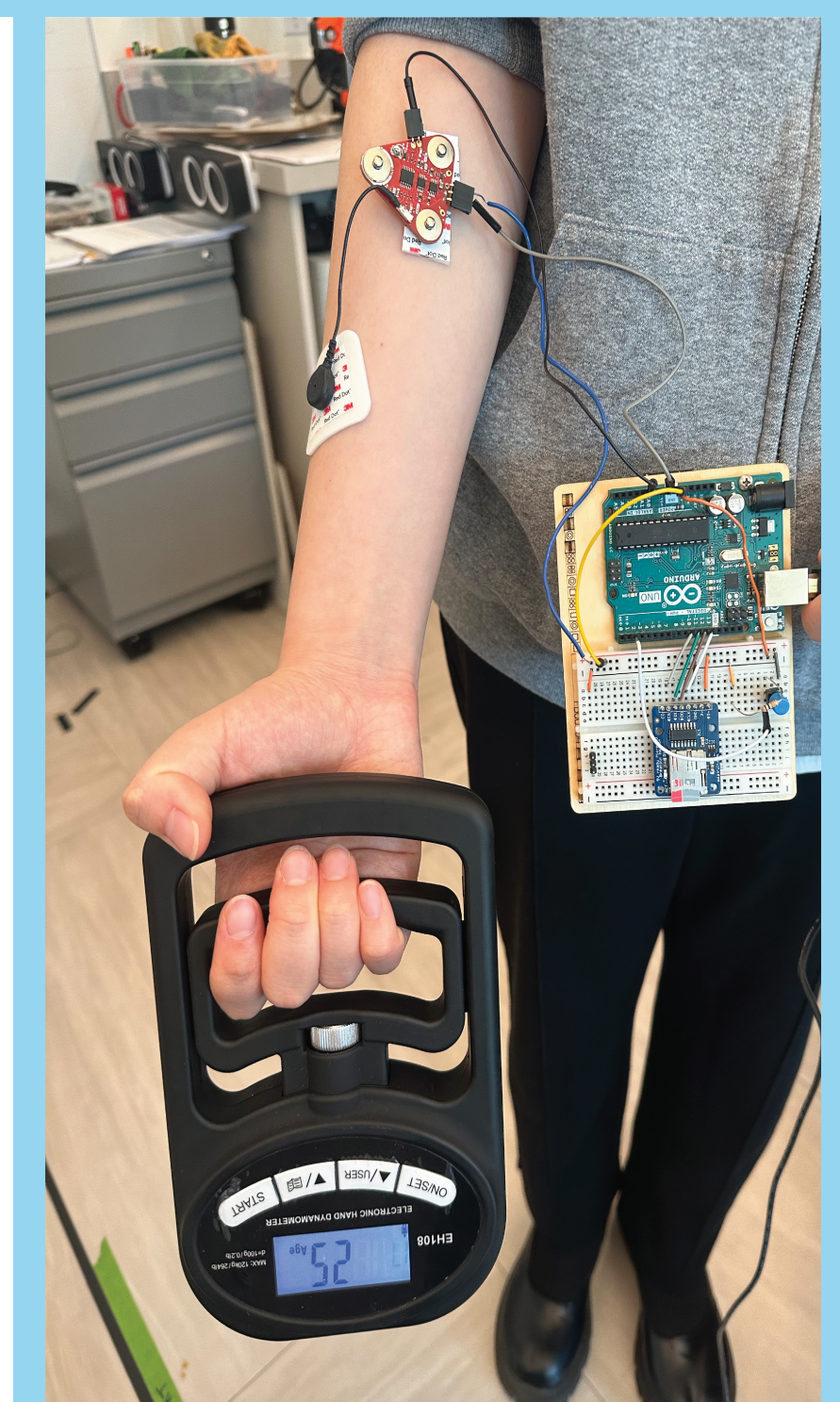
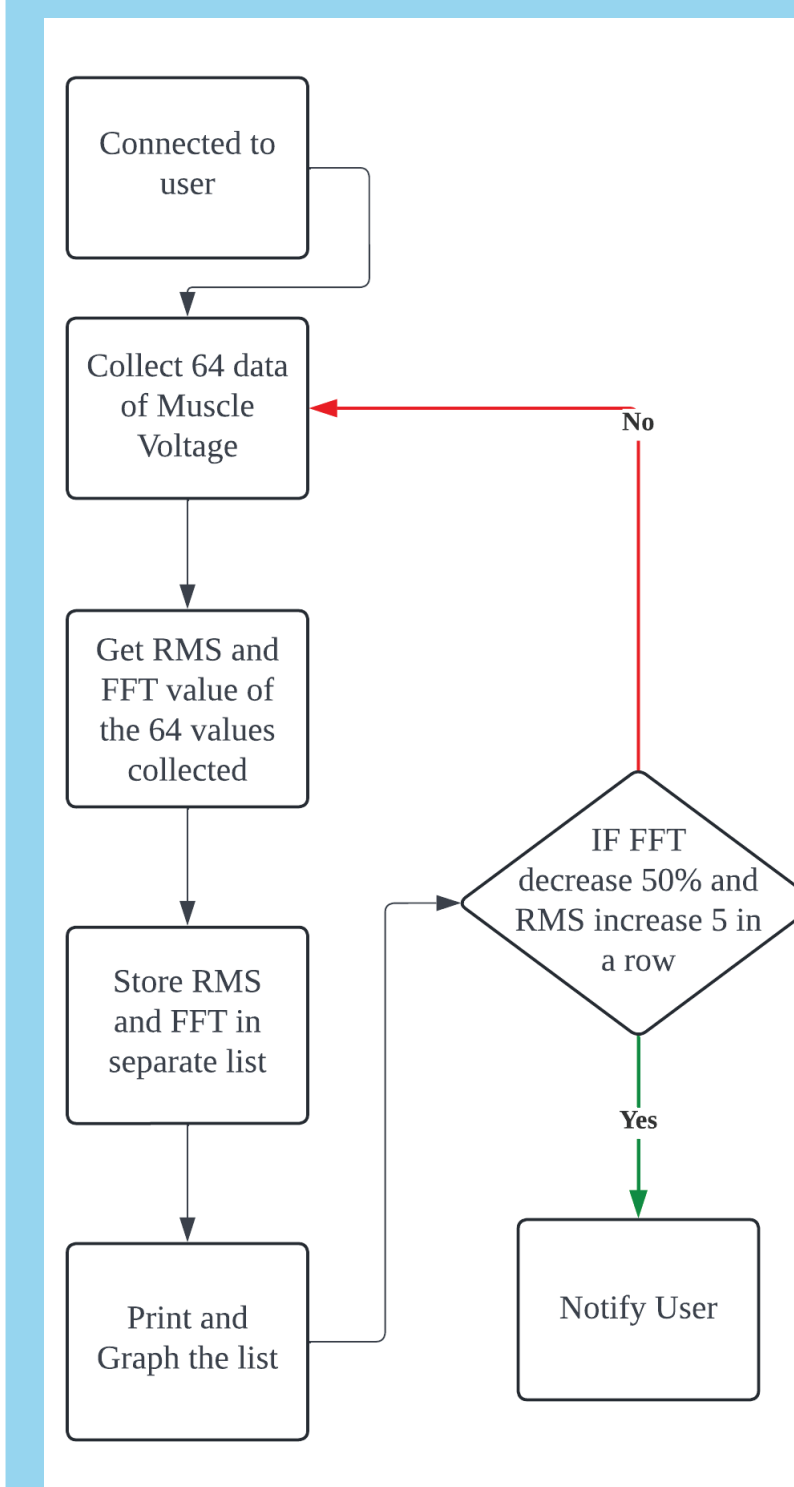
Relation between maximum grip force and SEMG's FFT and RMS value over time



← Muscle force output can be affected by external factors

As participants tire mentally during test administration, the desire to stop increases, eventually leading to frustration or anger. This was reflected on the force graph as a temporary increase in force output. The participants' ability to sustain the level of force gets shorter as they are more fatigued.

Software/Hardware Algorithm



Fatigue detection algorithm

Grip force test with the sEMG real time device

Acknowledgements

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Selected References

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