Measuring Hand Tremor with a Mobile Device
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MOTIVATIONS
To improve the healthcare of elders by allowing them to track hand tremor over time, identifying lifestyle factors that exacerbate or mitigate tremor as well as to implement a novel use of a mobile device—utilizing its sensor capabilities.

OPPORTUNITY
Mobile devices equipped with accelerometers are increasingly common, with hundreds of millions of smartphones now shipping annually. Such devices are often naturally available to users throughout the day and present an opportunity to track and improve healthcare. To explore this opportunity, we created and evaluated the feasibility of an application running on a mobile device that measures hand tremor using its internal triaxial accelerometer.

Measuring hand tremor on a mobile device has the potential to help those with hand tremor track and gain greater understanding of the tremor’s manifestation over time and help doctors make more informed diagnoses. Furthermore, we assess the potential use among healthy individuals as a health metric. To explore this potential, we compared various tremor measurements with sleep quality as assessed by the Pittsburgh Sleep Quality Inventory.

HARDWARE
T-Mobile G1 Phone with a Triaxial Accelerometer, running Google Android Operating System

APPLICATION
The developed application instructs users to hold the phone in their outstretched dominant hand and measures hand tremor over a specified period of time (typically 30 seconds). It then calculates statistics regarding the amplitude, period, and regularity of the hand tremor. Additionally, an optional UI was developed that provides real-time feedback; however, for data collection we opted for a static interface as the extra processing could lower the sampling rate and in user tests participants would introduce artificial hand tremor by trying to “play” with the interface.

STUDY & RESULTS
Data were first collected from volunteer students, faculty, and staff at the Carnegie Mellon’s Silicon Valley campus to develop and evolve the application. Once the application was finalized, data were collected from older adults at the Mountain View Senior Center. Initial data included one person with a tremor movement disorder; this participant agreed to use the application regularly for a week. Several times each day the participant took a measurement, noting whether her own perception was that there was no tremor (N=8), slight tremor (N=4), or clearly visible tremor (N=7). Throughout the week, the participant did not see any of the scores recorded by the application. Upon analysis, the application’s data corroborated the participant’s own perception:

Tremor amplitude proved telling within a single participant and Hz both within and between. At the Mountain View Senior Center, 19 Participants were run in all, with 5 reporting a history of muscle tremor. These participants also completed the Pittsburgh Sleep Quality Questionnaire. The results were extremely encouraging for the application’s feasibility:

- Comparing the two groups on frequency yields a t-score of 5.06 with a probability of less than 0.0005 that the result is chance

- A correlational analysis of PSQI scores and tremor frequency yields an r-score of 0.557 with a probability of less than 0.05 that the result occurred by chance