

Ergonomic and human interface design factors for home-based medical devices in movement disorders

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Introduction

Movement disorder monitoring technology was previously developed (Kinesia, Great Lakes NeuroTechnologies) to objectively quantify tremor and bradykinesia severity. Home monitoring increases the resolution of symptom capture and can expand clinical utility, but home monitoring of movement disorders requires very specific ergonomic and human factor design considerations. Based on the existing technology, a Parkinson's disease (PD) home monitoring system that utilizes accelerometers, gyroscopes, and patient diaries (Kinesia HomeView, GLN) was developed and modified based on feedback from several patient-centered focus groups in order to adequately address various ergonomic and human interface factors.

Methods

PD focus sessions were completed to evaluate and develop home monitoring technology (Figure 1). The first session examined the ease of use of hardware components through participant interaction with test models while remaining sessions examined hardware ergonomics and the software interface.

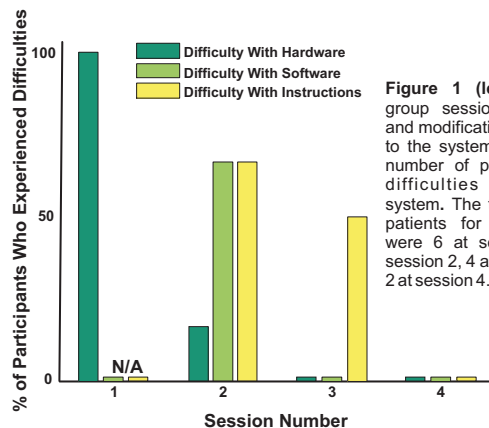


Figure 1 (left): As focus group sessions progressed and modifications were made to the system, a decreasing number of participants had difficulties utilizing the system. The total number of patients for each session were 6 at session 1, 3 at session 2, 4 at session 3, and 2 at session 4.

For sessions 2-4, participants were given a complete system to interact with the software and hardware interfaces, including following the video guided instructions for six motor assessments. At the conclusion of each session, participants completed surveys and several system features were updated to reflect user feedback. The improvements were then tested by the subsequent focus groups in order to determine whether the system was feasible for use by the PD population and, when necessary, update the system to resolve any related issues.

Evolution of Modifications

Hardware, software, and human interface development were separated in order to address focus group feedback

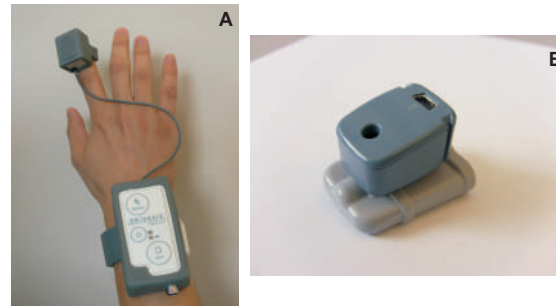


Figure 2: The original system consisted of a large wrist module and ring sensor (A) but was modified to only a ring sensor with a flexible silicone sleeve for simplified placement (B).

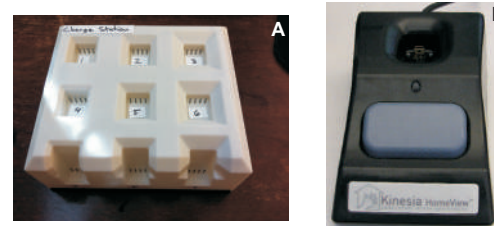


Figure 3: Nine different docking designs were given to participants to select the slot that was easiest to use (A). The resulting docking station utilizes a large button for easy release and a channel that guides the ring sensor into place by simply pushing down on its sleeve (B).

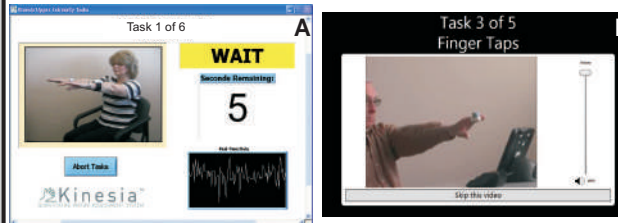


Figure 4: The original software had more information than necessary on the screen, which was confusing to the subjects (A). To account for this, we de-cluttered the screen and also added a feature that allowed the patients to skip a video instruction if they already knew how to perform a task (B).

Resulting System

By utilizing a docking station to complete the data transfer (as opposed to a USB cable) we improved the ergonomics that should lead to better patient compliance due to less reliance on fine dexterity.



Figure 5: Incorporating a docking station and minimizing the amount of information on the software encourages correct patient use. Additionally, a touch-screen PC with large buttons is important when designing a home monitor for patients with movement disorders.

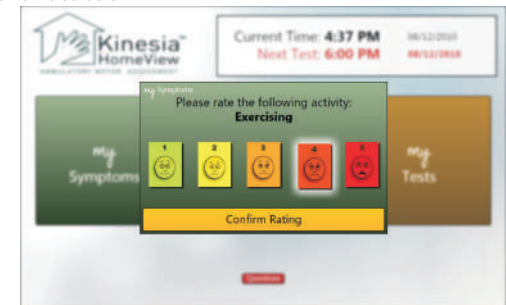


Figure 6: The patient diaries have a very straightforward rating system to encourage correct use. The elderly PD population needed to be considered when developing the system.

Conclusions

By involving the targeted movement disorder population during the development of a home monitoring system, patient compliance is likely to be improved. Patient feedback allowed us to dramatically improve Kinesia HomeView in order to best meet the user's needs. By the end of the fourth focus group, there were not any participants who struggled with the system, demonstrating the importance of involving a patient population early in the design process.

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