Fidget Knob: a haptic device to study fidgeting behaviors

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I. Introduction

Fidgeting with an object (e.g., a coin) is a ubiquitous haptic behavior [1], yet reasons for and effects of fidgeting are currently unclear [2]. We present Fidget Knob (Fig. 1) as a novel way to study fidgeting behaviors by enabling programmable haptic feedback in the form of digital detents and the ability to record the knob's movements. Fidget Knob was designed around the primary interaction of axial spinning or rotating, found to be a popular way of fidgeting [2, p.66].

II. Design and Use of Fidget Knob

Fidget Knob consists of a brushless DC motor, magnet, and radial magnetic position sensor aligned within a 3D-printed assembly, as well as a secondary box housing the control electronics, mode switch, indicator LED, and I/O ports. The knob's motion and haptic feedback is generated with a vector control (or 'field-oriented control') algorithm, capable of simulating different patterns and forces of 'digital detents' within the rotation of the knob. Fidget Knob is secured in a tabletop base and can also be easily removed to become handheld and support varied interaction.

The Knob's design allows a user to select a specific fidgeting mode using a push-button to suit their personal haptic feedback preference for fidgeting. In the current implementation, Fidget Knob, features nine preset modes of feedback meant to cover the general range of possibilities, from very fine to coarse detents, light to heavy forces, and more. A theoretically infinite number of patterns of haptic feedback can be programmed in advance.

Fidget Knob logs timestamped data at a net 20Hz (adjustable) for the knob's absolute position, angular velocity, and applied phase voltages, through USB serial connection and a Processing script. These data function as proxies for overall amount of use (position/distance), engagement frequency and urgency (velocity), and resistive force (applied voltage and position). Fidget Knob enables data logging and analysis of fidgeting interactions within a single device. This opens up several opportunities for researching fidgeting behaviors (e.g., changes in micro fidgeting behaviors over time), as well as behaviors in relation to a certain task environment (e.g., moments of fidgeting during a focused task).

An initial test with Fidget Knob was carried out with six participants (five female; age range 23-31) who were instructed to use the knob during a focused creative research task. Distinguishable, event-triggered patterns of fidgeting were captured by the data (Fig. 1). This initial test provides a solid foundation for further use in other research domains.

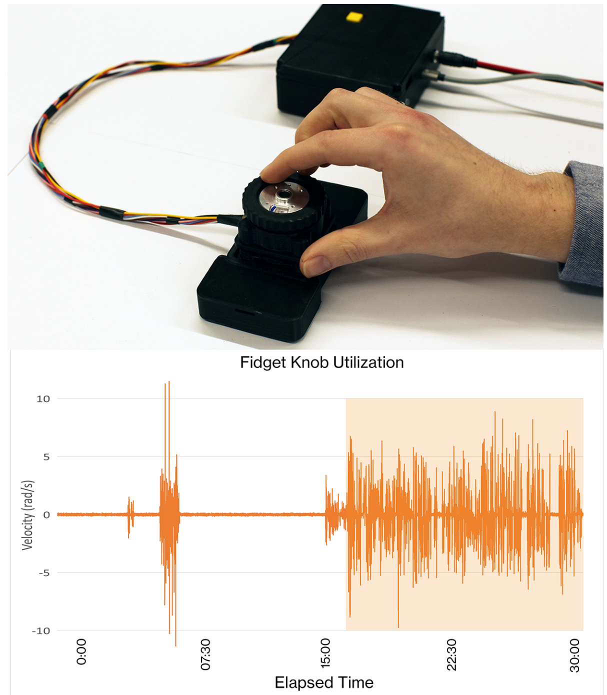

Fig. 1. Top: Fidget Knob with the control box visible in the background. Bottom: Fidget Knob data demonstrating external event triggered changes in fidgeting from baseline (orange highlight section).

III. Open Source Access

The specifications, software, CAD files, and instructions for Fidget Knob [3] are covered under the Apache 2.0 license, and can be found here: github.com/jeichenlaub/fidgetknob. We hope that by sharing the Fidget Knob designs we provide others with a platform to enhance their research into fidgeting behaviors.

References

[1] K. Isbister and Karlesky, Michael, "Understanding Fidget Widgets: Exploring the Design Space of Embodied Self-Regulation," in Proceedings of the 9th Nordic Conference on Human-Computer Interaction, Gothenburg Sweden: ACM, Oct. 2016, pp. 1–10.

[2] J. A. Eichenlaub, "Constructing Fidgeting: Integrating Extended Cognition, Mind Wandering, and Mindless Interaction in Pursuit of a Productive Mood State," Master thesis, Technische Universiteit Delft, 2022.

[3] J. A. Eichenlaub, "Fidget Knob: v1.0.0". Zenodo, Mar. 14, 2023. doi: 10.5281/zenodo.7732484.

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