# Resonant Relaxation: Affective State Change via Procedurally Generated Haptics

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**Abstract.** The ongoing shift towards digital sedentary lifestyles has increased stress in daily life and calls for innovative approaches to improve mental and physical health. This project explores the capabilities of AI-generated audio for affective haptic feedback to create experiences that induce relaxation and enhance emotional well-being and productivity. We designed a web application that allows haptic designers to create customized haptic patterns for respiration-based relaxation practices. Our system offers customizable parameters and leverages AI-driven audio-haptic composition to tailor relaxation experiences to individual user needs. Initial findings suggest that generative AI supports designers in creating personalized audio-haptic experiences, potentially reducing stress and improving relaxation. This lays the groundwork for future exploration into broader emotional state management.

**Keywords:** Affective Haptics · Generative AI · Audio-Haptic Feedback · Personalized Relaxation · Emotional Well-being

## 1 Introduction

In recent years, the shift towards sedentary lifestyles due to ongoing digitalization and globalization has highlighted the need for innovative approaches to maintaining mental and physical health. Traditional relaxation methods are often limited by modern living conditions, leading to the need for seamless solutions. Recent work has shown the potential of haptics to produce affective shifts in users [3]. Other work has shown the ability of AI to produce music to foster mindfulness, specifically with relaxation [4], potentially improving emotional well-being and productivity. In this paper, we explore the research question: "How could generative AI support designers in creating relaxation-inducing haptic experiences to enhance emotional well-being during sedentary activities?" We build on previous work using personalized audio to reduce breathing rates and induce relaxation [1, 2], and apply it within a haptic framework. Initial results highlight the challenge posed by the highly contextual nature of haptic stimulation — affected by

factors like baseline emotional state and environmental conditions — showing that intelligent and highly customizable solutions are needed to meet individual relaxation needs effectively.

## 2 Methodology

Our primary goal was to enhance users' emotional well-being during concentrated productivity or relaxation sessions by providing personalized audio-based haptic experiences that could promote relaxation and potentially facilitate a flow state. We focused on creating a baseline state for relaxation, upon which we could then create follow-up shifts in the emotional state. To achieve this, we developed a React-based web application capable of generating customized haptic patterns to induce relaxation. Using a ChatGPT API call, we generated initial MIDI compositions via a series of prompts. These MIDI compositions were converted into waveforms using a browser-based synthesizer, Tone.js, and played through various voice coil actuators as wristband or neckband wearables. The haptic output consisted of two sub-patterns: Firstly, an amplitude-modulated sine tone, which started at a frequency slightly higher than normal breathing and slowed down according to user-defined parameters to induce slower breathing; secondly, AI-generated MIDI "Sparkles", aligning with the music theory of the baseline note frequency, ensured the haptic experience remained engaging and novel. The web application combined the two in real time to create therapeutic soundscapes for haptic relaxation. We conducted an initial user test with three participants, each with a different sedentary workload, to collect qualitative feedback for our development process. Participants reported increased feelings of calm after using the system and preferred a variety of sparkles along with a relaxing baseline over a simple haptic baseline output. However, the user testing was limited and more extensive testing is planned for future iterations.

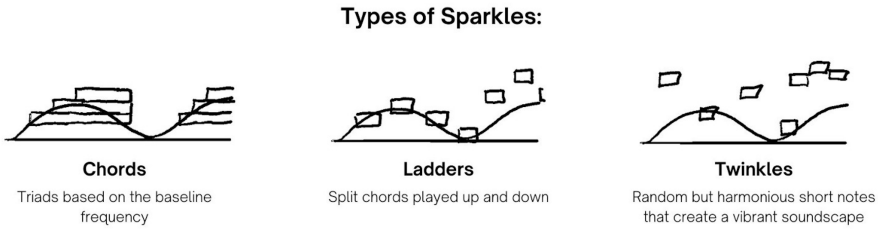


**Fig. 1.** Visualization of different types of musical note structures, generated using GPT-4 to add MIDI 'sparkles' on top of the baseline frequency.

## 3 Conclusion and Future Work

We developed a web application that enables haptic designers to procedurally generate fine-tuned haptic patterns[4]. It successfully met its primary objective by allowing designers to innovate and experiment with personalized relaxation experiences. However, there are areas for improvement, such as the need for more rigorous user testing. Future work will focus on expanding the prototype's capabilities based on initial findings. We will implement a more structured and extensive user testing phase to gather quantitative data on the system's performance and user satisfaction. Long-term studies are needed to assess the effects of regular use on emotional well-being and productivity. Also, the exploration of different embodiments and integration methods for haptic actuators could refine the comfort and usability of the system. Additionally, we aim to include sophisticated features such as Cycling '74's RNBO patches[5], which facilitate adjustable and deployable virtual instruments for audio-haptic playback. Utilizing technologies like local Large Language Models (LLMs) for generating procedurally-generated haptics or creating biofeedback loops can provide more effective, personalized experiences. These advancements could revolutionize interaction with affective haptic technology, making these experiences more immersive and tailored to individual needs. We invite haptic designers and researchers to build on this foundation and explore its potential to transform affective haptic user experiences across various domains.

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[5] RNBO: https://cycling74.com/products/rnbo