The Haptic Board

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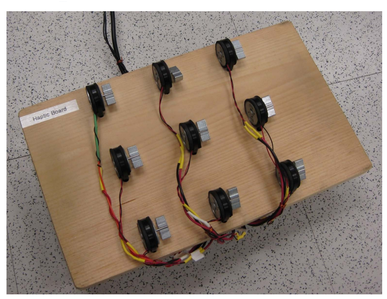
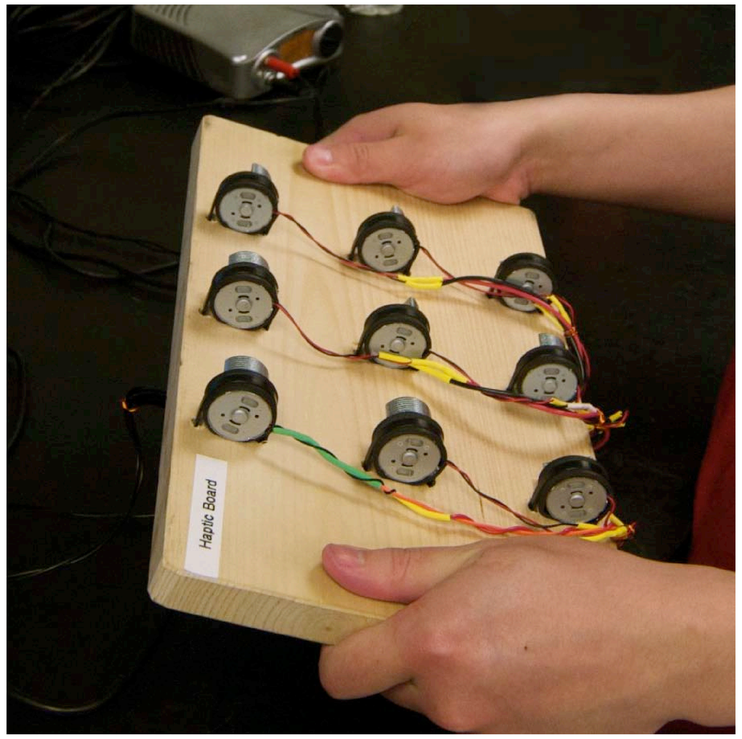
Motivation

Modern handheld electronics all provide beautiful graphics and high-quality audio, but they struggle to provide compelling touch-based feedback. We wanted to discover whether vibrotactile actuators could be extended beyond temporal cues to also provide spatial and directional information. What if you could feel the location of the Starship Enterprise as it flew across the screen of your iPad?

Mechanical Design

We tested many different actuators before finding one that provides strong location cues when mounted to a rigid handheld object. This 24 mm eccentric-mass DC motor is typically used in body massage and gaming products. Nine such motors are affixed to a rigid wooden board in a three-by-three array. The large offset mass of these motors creates a strong low-frequency vibration, which provides the user with a good cue about the location the motor in the plane.



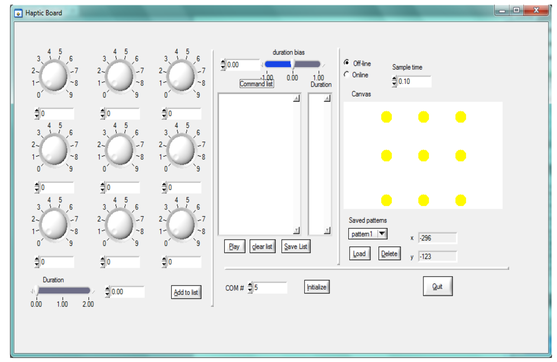


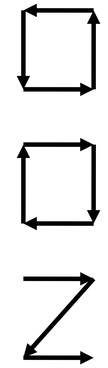
Overview

The Haptic Board is a custom handheld device designed to convey complex touch-based information for applications such as gaming and mobile computing. Instead of placing multiple tactile actuators on the skin, the system uses a sparse two-dimensional array of eccentric mass motors mounted to a rigid wooden board. The user holds the board in two hands and feels vibrotactile cues that are not only temporal but also spatial and directional. The key to the device's compelling feel is that activating neighboring motors in tandem creates the illusion that vibrations are emanating from a location between the two real actuator positions.

Control Interface

The Haptic Board is controlled by a host computer via a graphical user interface that was developed in LabWindowsCVI. The operator uses the mouse to specify how the center of vibration should move over time. The controller calculates the intensity with which the neighboring motors should vibrate, and it sends the corresponding PWM duty cycles to the board over the serial port.





Electronic Design

A PIC microcontroller interprets the commands send from the host computer and generates the PWM signal for each of the nine motors. Each duty cycle varies from 50% to 100%, and each motor is driven by a half H-bridge.