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# Sharing Skills with a Haptic Playback System: A Case Study on the Pottery Studio

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## I. INTRODUCTION

Craft skill learning involves subtle, embodied cues—such as fingertip contact, force distribution, and rhythmic control—that are difficult to perceive through visual media alone [1], [2]. Although visual-media-based methods, including remote instruction and post-hoc video reflection, are widely used in craft education, they often fail to convey the tactile nuances essential to material interaction. Previous work has explored visualizing muscle activity to support reflection, but such approaches lack direct bodily coupling and offer limited support for deeper kinesthetic understanding [3].


Fig. 1. Conceptual Representation: A potter recording his muscle activities and fingertip vibration with video, then re-experiencing the tactile cues generated by these data.

Considering the potential of sharing muscle activity as a means to enhance bodily understanding in craft-based interaction, we draw attention to research on kinesthetic information transmission. For example, Nishida et al. used EMG and EMS to reproduce muscle activation signals from individuals with Parkinson's onto another person's forearm, aiming to foster empathy through bodily signal sharing [4].

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Building on this direction, we present a wearable system that captures and replays multimodal data during craft activities—including forearm muscle activity (FMG), fingertip vibrations, and first-person video. We adopt rotational skin-stretch as our primary haptic cue modality, based on prior work demonstrating its effectiveness in supporting motor skill learning with minimal interference to hand movement [5].

## II. METHODOLOGY

The proposed system captures muscle activity and fingertip vibrations during craft activities and provides temporally synchronized haptic cues to support post-action reflection. As illustrated in Fig.2 and Fig.3, the system comprises three core components: a forearm-mounted muscle activity sensing module, a fingertip vibration recording module, and a wearable haptic display.

Muscle activity is measured using sixteen force-sensitive resistors (FSR402, Interlink Electronics) embedded in an adjustable wristband, referred to as SenseFuse™, designed by commissure Inc. The sensors are evenly distributed around the forearm to ensure stable skin contact and signal consistency. Analog signals are sampled at 240 Hz by an ESP32 microcontroller (XIAO ESP32C3, Seeed Studio) and transmitted wirelessly to a host computer for subsequent processing and analysis.

Fingertip vibrations are captured via three-axis accelerometers (2302B, Showa Measuring Instrument) embedded in the fingertips of a rubber glove. The signals are recorded using a digital audio recorder (ZOOM H6e, Zoom Corporation) at 48 kHz with 32-bit float resolution, preserving high-frequency characteristics for accurate tactile rendering.

To achieve precise temporal alignment across sensor streams, a sharp clap sound is used as a synchronization marker, simultaneously detectable in the FMG data, accelerometer signal, and video audio track. FMG data is subsequently downsampled to 60 Hz to match the video frame rate, then normalized and smoothed using a Gaussian filter. Accelerometer signals are low-pass filtered and amplitude-limited to suppress noise and spurious peaks.

Haptic cues are delivered through FeelFuse™, a wearable feedback device designed by commissure Inc. [6]. It is equipped with four rotational skin-stretch actuators and two vibrotactile motors. FMG signals are mapped to servo motor angles to indicate changes in muscle activation intensity, while accelerometer signals directly drive the vibration motors via an audio amplifier. Motor control is handled by a

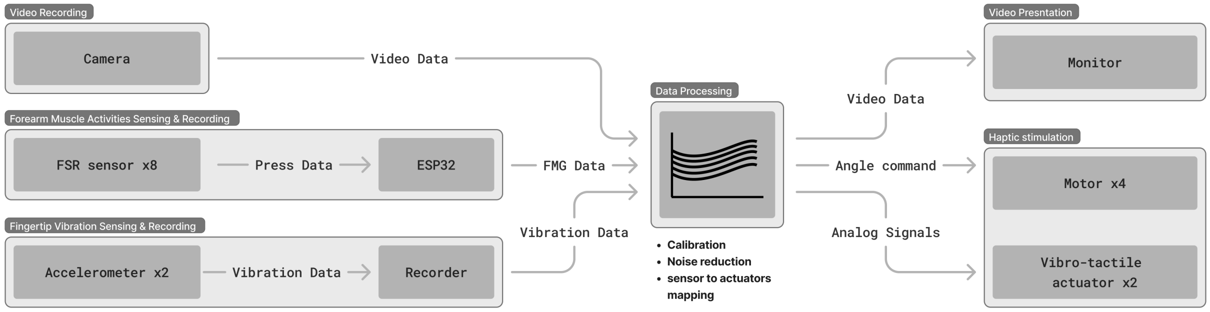


Fig. 2. System architecture

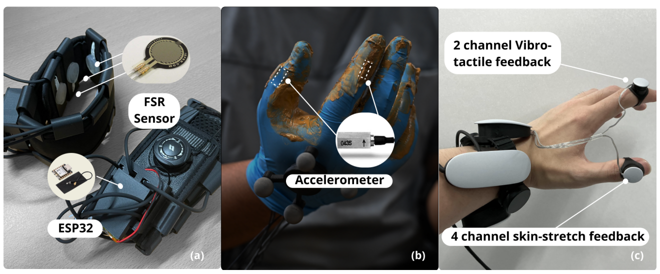


Fig. 3. (a) FMG device (b) Accelerometer (c) Haptic display Feeltech wear [6]

custom STM32-based controller.

Playback control and visualization are implemented in TouchDesigner, where the synchronized video, FMG, and vibration data are rendered along a unified timeline. During playback, skin-stretch and vibrotactile actuators provide users with embodied cues that highlight muscle effort and fingertip contact dynamics. This integration facilitates reflective awareness of bodily technique by making subtle sensorimotor patterns perceivable through touch.

## III. Workshops and Findings

To assess the system's potential for supporting skill reflection, we recorded a professional potter during a wheel-throwing task while wearing the sensing modules. The captured FMG, accelerometer, and external video data were processed into a synchronized playback experience. Two workshops were conducted: Workshop 1 (n=1) involved the recorded potter reflecting on their own performance, while Workshop 2 (n=5) included additional potters with varying experience levels who observed and discussed the same data. Each participant reviewed the session under two conditions—visual-only and visual + haptic (skin-stretch and vibration)—and engaged in "speak-aloud" reflection followed by interviews and group discussion.

Participants consistently reported that haptic cues were temporally aligned with visual events. In Workshop 1, the potter discovered an unnoticed force imbalance between the hands, revising assumptions about dominant-hand usage. In Workshop 2, participants noted similar skin-stretch intensity between the centering and lifting phases, leading to the hypothesis that the potter may have stabilized the arm using the legs—an insight later confirmed through discussion. These findings suggest that haptic-enhanced playback can uncover subtle variations in force and contact timing, deepening individual reflection and facilitating more informed collective interpretation.

## IV. Conclusion

We developed a wearable system that records and replays multimodal data—muscle activity, fingertip vibration, and external video—mapped into skin-stretch and vibrotactile feedback. A pottery-based study confirmed that the system provides temporally synchronized feedback, enhancing users' perception of subtle force dynamics. The findings highlight the value of haptic augmentation for skill reflection and embodied understanding. Future work will involve hardware refinements and broader user testing to assess learning outcomes across varying skill levels.

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