Qìfield: Externalizing Qi as a Palmar Haptic Field for Volitional Extension in Tai Chi Practices

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Figure 1: Overview of *Qìfield*: a VR Tai Chi system that couples EMG-driven effort with palm airflow and visual feedback to externalize volitional flow across intention, force and movement.

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Abstract

Tai Chi is a traditional Chinese somatic practice that requires the mastery of not only physical movement, but also of 'Qi', the coordinated regulation of intention, breath, movement, and force. Drawing on interview results with 5 professional Tai Chi practitioners, we introduce *Volitional Extension* as an interaction-oriented lens for supporting the outward continuation of intention through force into action. Grounded on this concept, we design *Qìfield*, a multisensory system that externalizes this internal coordination through palm-centered airflow and vibrotactile feedback modulated by forearm EMG and hand gestures within a VR environment. We then conducted a preliminary study with 12 participants using the *Qìfield* system and collected qualitative feedback. Our results suggest that combined airflow and vibration can support subtle internal sensations, sensorimotor calibration, and foster a sense of extension beyond the hand. Our work contributes empirical evidence that multimodal haptics can render abstract somatic concepts perceptible, advancing their potential role in embodied skill learning.

CCS Concepts

• **Human-centered computing** → **HCI design and evaluation methods**; *Empirical studies in HCI*; *Virtual reality*; • **Applied computing** → *Interactive learning environments.*

Keywords

Cultural Heritage; Haptics; Motor Learning; Somatic Awareness; Tai Chi; Embodied Interaction; Qualitative Methods

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1 Background and Introduction

In the field of Human-Computer Interaction (HCI), prior work has explored how interactive systems scaffold embodied learning and reflection across cultural, artistic, and motor practices [2, 12, 25, 29, 32, 38, 48]. These studies show that somatosensory cues can function as central resources for constructing bodily meaning and expertise. Related systems have demonstrated how interactive artifacts can reshape practitioners' self-understanding [28], translate embodied experience into haptic form [23], and support shared bodily awareness in training contexts [41]. Taken together, these works revealed how somatic experiences can be achieved through giving physical form to experiences that are hard to articulate [19]. While prior work on tangibilization has primarily targeted external information, or social signals, few systems address internally regulated bodily processes such as intention, force, and their continuous coordination during skilled practice. This gap is especially salient in somatic disciplines like Tai Chi, where core experiential constructs are cultivated through felt continuity rather than explicit instruction.

Tai Chi is a traditional Chinese somatic practice widely practiced in East Asia and beyond [26, 27, 37, 44]. Extensive literature reports its benefits for cognitive function, physical performance, and mental wellbeing [5, 10, 17, 35].Central to Tai Chi practice is the concept of *Qi*, commonly described by practitioners as a felt coherence among intention, breath, posture, and force. Rather than a metaphysical substance, *Qi* functions as an experiential organization of bodily awareness and action, often sensed as flow, expansion, redirection, or emission—particularly through the palms.

Consistent with other forms of somatic practices [28, 39], the core principles of *'Qi'* are inherently difficult to articulate, teach, and learn [16, 46]. Therefore, instructions often prioritize external choreography, such as form names and movement sequences, rather than the embodied meanings underlying each posture [1, 36]. As a result, many novices learn to reproduce the motions, but struggle to develop the internally regulated, intention-driven.

Existing Tai Chi technologies focus primarily on kinematic accuracy, safety, and observable performance, using motion capture, computer vision, machine learning, or VR/AR to assess posture and provide corrective feedback [8, 9, 11, 21, 22, 24, 30, 34, 40, 42, 43]. Although effective for movement standardization and rehabilitation, these systems rarely address the fine-grained, multimodal bodily sensations through which practitioners experience *Qi*. Prior research on multimodal and thermal haptics indicates that different combinations of tactile, thermal, and proprioceptive cues can shape motor learning and postural control [12, 25, 33]. Airflow- and mist-based interfaces further show that subtle flows on the skin can serve as effective haptic pointers, breathing guides, or interaction media, leveraging users' proprioception and interoception [13, 14, 20, 31, 45, 47]. Yet these technologies have rarely been integrated with Tai Chi's specific movement vocabulary and cultural metaphors, nor systematically explored as a way to render directional, continuous *Qi* flows that intertwine with intention, force and movement.

In this research, we introduce *Volitional Extension* as an analytic and design-oriented construct: the felt outward continuation of intention through force into action. Rather than redefining *Qi*, Volitional Extension offers an operational lens for externalizing, supporting, and systematically studying a core experiential dimension of Tai Chi practice within interactive systems. Our research is guided by these research questions. **RQ1**: How do Tai Chi experts describe and recognize the coupling of intention, movement, breath, and force during practice, and what observable cues indicate its emergence or breakdown? **RQ2**: How do novice practitioners perceive the multisensory externalization of *Qi* sensations?

To address these questions, we adopt a three-phase approach. Phase I comprises a formative study with experienced Tai Chi instructors and practitioners to ground our design in expert understanding. Phase II translates these insights into *QìField*, a multimodal VR Tai Chi prototype that externalizes volitional effort through palmar haptics modulated by forearm EMG. Phase III reports a pilot study evaluating how different haptic modalities influence perceived Volitional Extension and learning engagement.

Our contributions are: (1) We introduce Volitional Extension as an interaction-oriented lens for supporting the experiential coupling of intention, movement, and force in Tai Chi practice. (2) We present Qìfield, a multisensory haptic and VR Tai Chi system that

externalizes volitional effort through palm-centered airflow and vibrotactile feedback modulated by EMG and gesture phases. (3) We report exploratory findings from a pilot study showing how multimodal haptic experience may support beyond-hand extension, sensorimotor calibration, and embodied engagement in mindful movement.

2 Design and Implementation

2.1 Formative Study of Volitional Extension

To understand how to better externalizing 'Qi' for Tai Chi practices, we conducted a formative study with experienced Tai Chi practitioners and instructors. The study aimed to answer **RQ1**.

Rather than treating Qi as a metaphysical entity, experts consistently framed it as a *process-level organization* of intention, breath, movement and force unfolding through the kinetic chain. This forms our our notion of *Volitional Extension*: the felt outward continuation of intention through force into action. We therefore focused on extracting *operational cues* that experts use in teaching and evaluation. Table 1 summarizes the interviewed experts and interview focus. The resulting expert-derived themes and their corresponding design requirements are consolidated in Table 2.

2.2 Prototype

We developed our prototype that externalizes *Volitional Extension* through palm-centered haptics aligned with movement, breath, and effort. The design follows a consistent control–to–cue mapping informed by expert accounts of intentional coupling (see Table 2): EMG has been widely used as an index of muscle activation and effort scaling in motor control research. In our system, EMG serves as an operational index of peripheral motor activation and is used as a continuous modulation parameter for haptic intensity, rather than as a direct measure of intention. Hand gesture and palm orientation determine cue direction and timing. Haptic cues are gated by gesture phase and rising EMG activity, prioritizing temporal alignment over magnitude and treating the palm as the expressive endpoint of the kinetic chain.

The palmar device integrates a central airflow actuator with three fingertip vibration tactors, complemented by a forearm EMG sensor (Fig. 4). This palm-centric configuration reflects expert emphasis that effective force transmission should *arrive at the palm* as the culmination of whole-body coordination, rather than being locally generated by the hand.

Haptic feedback employs a compact pattern set to distinguish two complementary Tai Chi qualities. The release energy, *Fajin*, is rendered as brief, synchronous pulses to mark well-timed emission, followed by rapid relaxation, whereas the dissolve energy, *huajin*, is conveyed through slower, directional sweeps, optionally reinforced with airflow to support continuous redirection. Across both patterns, intensity is softly bounded and smoothed to maintain comfort and align with Tai Chi's emphasis on continuity and control, enabling learners to experience volitional extension without overwhelming internal perception.

3 Pilot Study

We conducted an in-lab, within-session study to examine how combined palm airflow and vibrotactile feedback shapes participants' embodied experience of Tai Chi, particularly the perceived extension of intention/force beyond the body and the role of haptic cues in supporting (or disrupting) that experience. The research received IRB approval, and informed consent was obtained from all participants involved. The study aims to answer **RQ2**.

3.1 Procedures and Measure

Each session consisted of (1) onboarding and calibration, (2) a Free Exploration phase, (3) a Guided phase, and (4) post-task open-ended questions and a short interview. They were then introduced to the Tai Chi actions used in the study without explicit instruction about *Qi* or Volitional Extension.

We collected qualitative data through two open-ended prompts administered immediately after the Guided phase, followed by a short semi-structured interview. The open-ended prompts were: **F1 (Volitional Extension):** Does your intention or force extend beyond your body? If yes, how? and **F2 (Role of Haptics):** How did airflow and vibration help or interfere with that experience?

3.2 Participants

Twelve participants (8 female, 4 male; age 18–32) were recruited from a university population. Three reported limited prior Tai Chi exposure; the remainder were novices. None had prior experience with our system. All participants provided informed consent.

3.3 Data Analysis

We followed the reflexive thematic analysis approach [3] to code participants' open-ended responses. The first author initially coded the questionnaires and audio transcripts using an inductive approach. Codes were then discussed with the rest of the research team. The first author is an amateur Tai Chi practitioner and holds a master's degree in sports science. The research team consists of HCI researchers with prior experience in haptics and qualitative research, a national-level Tai Chi athlete, and two researchers from sports science.

3.4 Results

Extended body schema via externalized "Qi" Many participants reported that awareness, force, or "Qi" felt as if it extended beyond the hand and projected outward into space (F1). This beyond-body sensation was often described as flow or expansion (e.g., "feel my awareness extend beyond body"[P1]; " Qi flowed outward along my fingertips" [P2];"force released outward" [P4]). Airflow and vibration further externalized an otherwise subtle internal feeling, making it more explicit and tangible (e.g., "made it more visible" [P5]).

Sensorimotor contingencies supporting skill acquisition Participants frequently interpreted the multimodal feedback as actionable cues for learning "correct" force application (F2). Airflow and vibration helped calibrate force magnitude, posture, and force-transfer during palm pushing, increasing clarity of movement execution (e.g., "made my force application much clearer" [P3]; "helped me understand how much force to apply and adjust my posture" [P5]). Feedback also shaped attention and engagement: the absence of cues was taken as insufficient focus (e.g., "if it did

ID	Age	Edu.	Role / Title	Practice	Teaching	Styles / Background
E1	24	B.S.	National-level elite athlete; university instructor	~10y	~6y	Standard routines; Chen / Yang / Wu
E2	25	M.S.	Competitive Tai Chi athlete; instructor	~13y	~6–7y	Competitive Tai Chi; Chen and Yang
E3	22	B.S.	National first-class athlete; training coach	~11y	~5y	Tai Chi; Chen and Wu
E4	28	M.S.	National-level elite athlete; university instructor	~13y	~4y	Competitive Tai Chi; university instruction
E5	26	M.S.	National-level elite athlete; university instructor	~19y	~3y	Wushu routines / Tai Chi

Table 1: Interviewed Experts

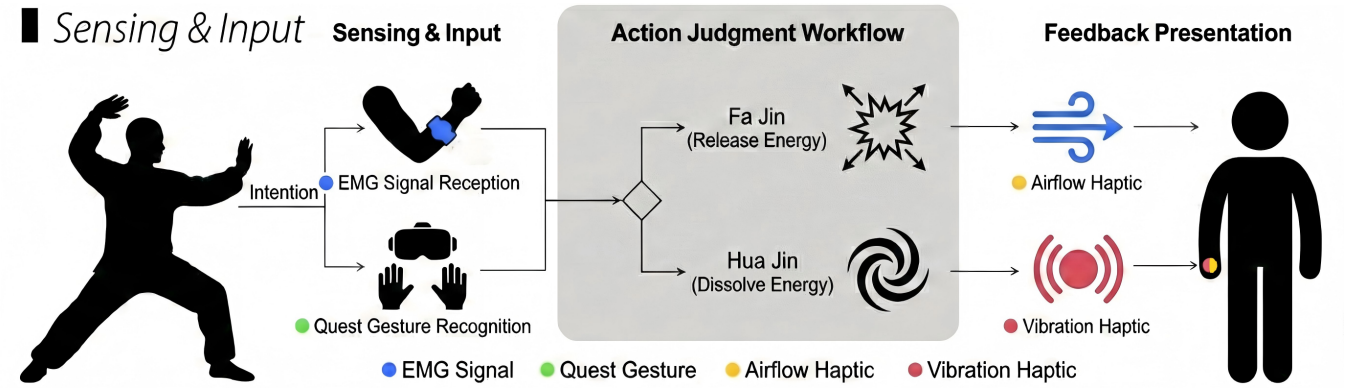

Figure 2: The concept framework of Qi field.

RQ1 Theme	Expert recognition of intentional cues	Design requirements (externalizing Volitional Extension)
T1 Timing integration	Qi is recognized when intention, breathing, and force are phase-aligned; lost when timing drifts despite correct form.	Phase-precise cueing gated by movement phase; prioritize temporal alignment over raw intensity.
T2 Palm-centric endpoint	Force should arrive at the palm as the endpoint of whole-body transmission; breakdown when the hand initiates locally.	Palm-centered mapping as the anchor for volitional expression; mitigate hand-leading errors.
T3 Through-flow continuity	Quality judged by continuous legs→waist→hand transmission and its consequence.	Directional, sustained cues to convey continuous outward extension beyond the body.
T4 Fajin / Huajin pairing	Fajin as brief emission with rapid return; Huajin as continuous redirection without resistance.	Distinct temporal profiles: short pulses for fajin; slower directional sweeps for huajin.
T5 Progressive learnability	Qi-related abstractions require gradual exposure and minimal guidance.	Minimal-sufficient cueing with progressive offloading as volitional control stabilizes.

Table 2: Volitional Extension: Mapping expert-derived intentioanl cues (RQ1) to design requirements.

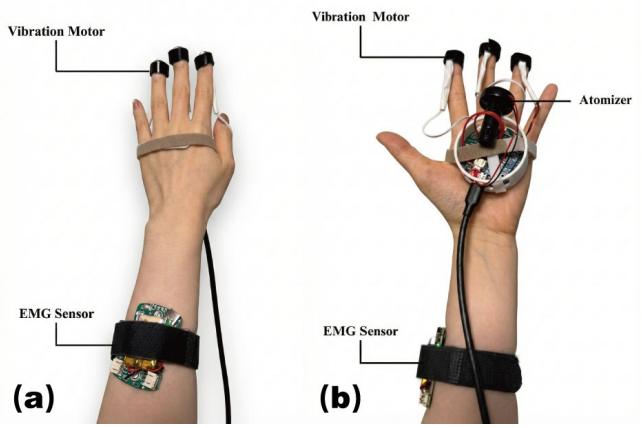

Figure 3: Palmar haptic prototype with airflow and vibrotactile feedback: (a) front view; (b) back view.

not trigger, my attention was not sufficiently focused" [P1];"more immersed, more focused" [P2]).

Multisensory integration shaped by cue reliability Participants experienced 'Qi' as an integrated multisensory construct combining visual effects, sound, airflow, and vibration (F2), especially during slow pushing/pressing (e.g., "visual forms of Qi, sound, and even vibration appeared" [P8]). However, cue contributions were uneven: airflow was often reported as more informative, whereas vibration was sometimes less legible or secondary (e.g., "vibration played a relatively minor role" [P4]; "vibration patterns were not very distinct" [P9]).

4 Discussion

Our multi-stakeholder pipeline operationalizes Tai Chi's intentional coupling as a design target by translating expert recognition cues into phase-gated, palm-anchored haptics (Table 2) and evaluating how learners experience these cues in practice. Embodied interaction does not automatically yield embodied cognition, we believe that designs must explicitly support meaning-making rather than only enforcing correct movements [6]. In this exploratory context, participants' descriptions suggest a shift of attention from external choreography toward felt coordination during practice. Rather

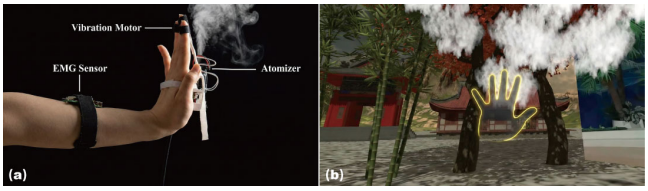

Figure 4: Palmar haptic prototype with airflow and vibrotactile feedback: (a) airflow output during interaction; (b) VR perspective of Qi output.

Theme	Description	Participants	Exemplar
T1 (EBS)	Awareness/force/"Qi" perceived as extending beyond the hand; airflow/vibration externalize the sensation, making the boundary shift tangible (extended body schema).	P1, P2, P4–P6	"Qi expands outward." (P6)
T2 (SMC)	Actionable action–feedback contingencies calibrate force, posture, and force-application points; trigger absence signals insufficient attention, scaffolding skill acquisition (sensorimotor contingency).	P1, P3, P5, P7, P9–P11	"It showed whether my movement was accurate." (P8)
T3 (MSI)	"Qi" emerges from integrated audiovisual–haptic cues; participants weight channels by reliability (airflow dominant; vibration less legible), consistent with reliability-weighted multisensory integration.	P4, P8, P9, P11	"Airflow helped most; vibration was minor." (P4)

Table 3: Themes from open-ended responses (F1–F2). EBS=Extended Body Schema; SMC=Sensorimotor Contingency; MSI=Multisensory Integration.

than emphasizing kinematic correction, the system appears to foreground the experiential organization of intention, breath, and force through sensing and feedback [7, 15, 25, 48].

Our expert interviews framed Qi not as metaphysics but as process-level coordination across the kinetic chain, emphasizing timing integration and palm cues. In the user study, participants reported a tangible beyond-hand extension of awareness/force/"Qi," aligning with externalization of subtle internal states. They also described learnable action–feedback contingencies that guided attention and clarified force application or posture. Participants' accounts further reflected reliability-weighted multisensory integration, with airflow often perceived as more legible than vibration.

while sense of agency concerns the attribution of action outcomes to oneself,[4, 18], Volitional Extension emphasizes the spatial and kinetic continuity of intention–force transmission across the body-to-space interface. In this framing, the palm functions as a perceptual endpoint of coordinated transmission. Our findings provide preliminary phenomenological evidence that such cueing may support novices in monitoring and regulating motor activation during practice, rather than solely reproducing external form.

In HCI cultural heritage studies, many systems prioritize contextual comprehension through narrative or multimodal experience [16, 46]. Our findings suggest a complementary route: structuring multisensory cues around practice-internal recognition rules (timing, endpoint, through-flow) can support *embodied acquisition* of tacit meanings. Design-wise, T3 implies that Volitional Extension depends on cue discriminability and stable timing; airflow can act as a primary directional carrier, while vibration patterns should be made more distinct to avoid being down-weighted.

This work has several limitations. First, the pilot study relies primarily on qualitative self-reports and does not include quantitative measures of movement accuracy, timing precision, or learning outcomes. As a short exploratory study, our goal was to examine phenomenological experience rather than system performance. Second, we did not include controlled modality comparisons (e.g., airflow-only vs. vibration-only) or latency benchmarking. Finally, EMG reflects peripheral muscle activation and may be influenced by co-contraction or fatigue, which were not systematically controlled. Future controlled studies will address these aspects through quantitative validation and longitudinal evaluation.

5 Conclusion and Future Work

We present *QiField*, a VR Tai Chi system that externalizes *'Qi'* through palm-centered airflow and vibrotactile feedback aligned with movement phase and volitional effort. Grounded in expert insights, our prototype implements phase-gated, palm-anchored cueing and a compact pattern set for releasing and dissolving energy. qualitative results revealed beyond-hand extension enabled by externalized "Qi", learnable action–feedback supporting attention and technique calibration, and reliability-weighted multisensory integration with airflow dominance. Future work will test longitudinal retention/transfer, refine vibration legibility and cue reliability, and explore teacher-in-the-loop authoring for progressive cue offloading in skill learning and soma design.

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