MPHIL / PHD PRACTICE-BASED RESEARCH PROPOSAL · ~1,000 WORDS (EXCLUDING BIBLIOGRAPHY)

Tangible Experiential AI: Spatial-Temporal Instruments for Auditable Human–Machine Reflection

> **Research Area Alignment: RCA School of Design (Tangible Interaction & Critical AI Design) / Edinburgh College of Art & Edinburgh Futures Institute (Experiential AI)**

1. OVERVIEW & CORE RESEARCH QUESTIONS (~170 WORDS)

Contemporary generative language systems inhabit stateless browser text boxes that obscure computational criteria behind conversational fluency. This practice-based doctoral inquiry investigates how replacing keyboard prompts with calibrated electromechanical rotation restructures human interpretation and epistemic clarity during algorithmic reflection. Working across industrial CAD, embedded optical sensing, and deterministic narrative extraction, the project develops *Tangible Cartographic Interface*: a three-bay physical instrument combining a ball-transfer optical sphere, stepped concentric time dials, and permanent paper ticket printing.

- **RQ1:** How does continuous tactile manipulation of spatial coordinates and mechanical temporal dials alter interpretive agency and deliberative pacing compared with standard browser chat interfaces?
- **RQ2:** Can an explicit multi-stage symbolic pipeline (deterministic salience scoring separated strictly from natural-language synthesis) convert opaque machine inferences into inspectable physical artifacts?

2. CONTEXT, LITERATURE & GAP IN PRACTICE (~320 WORDS)

Research in tangible user interfaces demonstrated early on that physical coupling anchors abstract computation inside everyday spatial perception (Ishii & Ullmer, 1997; Dourish, 2001). While consumer electronics converged broadly onto flat glass screens and predictive keystrokes, tangible computing principles rarely governed conversational artificial intelligence. Parallel work in *Experiential AI* (Hemment et al., 2019) argues that algorithmic boundaries and internal logics should become legible through artistic materiality and experiential encounter rather than purely quantitative Explainable AI dashboards.

At the same time, Gestalt-inspired phenomenological traditions examine contact across organism-environment boundaries through concrete situational prompts and shared objects (Perls, Hefferline, & Goodman, 1951). Across interactive museum design and human–computer interaction, existing AI installations frequently stage passive voice recognition or rapid screen text while leaving causal rules hidden inside undifferentiated language-model calls. The gap addressed here sits precisely at the junction of tactile instrumentation, transparent symbolic constraint architecture, and physical print ephemerality: testing a self-contained artifact whose mechanical resistance, deterministic scoring rules, and restrained paper output expose machine framing openly for critical scrutiny.

3. PRACTICE-BASED METHODOLOGY & STUDIO–THESIS INTEGRATION (~280 WORDS)

Studio fabrication and critical scholarship operate as one tight feedback cycle. Existing prototype work provides an operational bench platform (`prototype-workbench` and `astrofocus`) integrating dual orthogonal `PMW3360` optical flow sensors (1,000Hz) with a central `TLV493D` three-axis magnetometer underneath an unconstrained 170mm sphere, alongside five stepped Ziggurat date dials inspected via an internal 45-degree optical camera. Physical parameter changes (bearing friction, optical focal depth, ring step geometry) directly alter participant exploration duration and interpretive posture.

On the software layer, every locked spatial-temporal coordinate traverses a separated three-stage architecture: (1) mathematical salience scoring isolating high-load polarity axes alongside automatic default inertia using Swiss Ephemeris calculation, (2) retrieval across a locked 41-article environmental corpus, and (3)

conversational synthesis outputting strictly in plain human prose onto a compact display and 58mm archival thermal ticket. Exhibition deployments at partner cultural venues and structured talk-aloud user sessions gather empirical observation comparing printed tactile sessions against equivalent browser-based dialogue sessions. Studio making generates controlled comparative evidence, while thesis writing critiques epistemic authority, instrumental ritual, and transparent AI boundaries.

4. EXPECTED OUTCOMES & ORIGINAL CONTRIBUTION (~140 WORDS)

This doctorate delivers three coordinated contributions: (1) an exhibition-grade physical instrument alongside open-hardware CAD schematics and firmware for contactless dual-sensor sphere tracking; (2) an empirical design taxonomy linking slow mechanical input pacing to algorithmic legibility within *Experiential AI* practice; and (3) documented field studies evaluating tactile conversational artifacts across cultural exhibitions and reflective workshop environments. Beneficiaries span human–computer interaction researchers, museum media-art programmers, interactive design studios, and critical AI humanities scholars examining alternatives to screen-bound language interfaces.

5. INDICATIVE THREE-YEAR PLAN & TECHNICAL FACILITIES

PHASE	RESEARCH & FABRICATION MILESTONES	REQUIRED FACILITIES & RESOURCES
Year 1	Systematic literature review (Experiential AI, TUI, phenomenology); optical sensor tolerance refinement; ceramic/brass sphere casting; ethics protocol design.	CNC / additive fabrication workshop, electronics bench, optical calibration rig.
Year 2	Comparative empirical trials (`hardware plinth` vs. `web chat` sessions); public exhibition installation deployments; qualitative analysis of printed visitor transcripts.	Gallery testing space, thermal print consumables, embedded Linux telemetry logging.
Year 3	Iterative synthesis of final exhibited prototype; viva artifact curation; drafting and submission of full written thesis connecting studio outcomes to theoretical claims.	Exhibition documentation studio, thesis supervision & academic dissemination travel.

6. SELECTED BIBLIOGRAPHY

Dourish, P. (2001). *Where the action is: The foundations of embodied interaction*. The MIT Press.

Hemment, D., Aylett, R., Belle, V., Murray-Rust, D., Luger, E., Hillston, J., Rovatsos, M., & Broz, F. (2019). Experiential AI. *AI Matters*, 5(1), 25–31.

Ishii, H., & Ullmer, B. (1997). Tangible bits: Towards seamless interfaces between people, bits and atoms. In *Proceedings of ACM CHI '97* (pp. 234–241). ACM.

Perls, F., Hefferline, R. F., & Goodman, P. (1951). *Gestalt therapy: Excitement and growth in the human personality*. The Julian Press.


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Operational Hardware & Triptych Video: https://www.thearenatheory.com/astrolobe/
Live Separated AI Pipeline Reference : https://www.thearenatheory.com/chat.html
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