

LAB NOTEBOOK · dated

THE LAB NOTEBOOK

A brain–computer interface for under £600

In April 2026 we designed a non-invasive, bidirectional BCI — EMG cursor control, EEG reading, and PEMF stimulation — for around £500–£606, grounded in two decades of published neuroscience. Design-first: eight review reports and the IP filed before code. Neuralink-class ambition at a fraction of the cost. An open-hardware, open-build report by choice.

The dated R&D archive

 Research — measured, partial

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01 The entry, dated

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04 What we learned — including the honest edges

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06 Sources, glossary & the honesty ledger

Every claim carries its tier · nothing faked

PREPARED

10 April 2026

VERIFIED BY

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15 years building safety-critical
systems

HOW TO READ IT

Drafted with AI, verified by a
named human. Sources at the back.

01 The entry, dated



The entry, dated

Apr 2026

entry date

Hardware

category

~1-2 years ahead

lead over the world



Public

access

What the world had at the time

The headline in brain-computer interfaces is invasive, surgical, and eye-wateringly expensive. A non-invasive, bidirectional device for the price of a phone, built on published science, sits in a gap almost nobody is working in the open.

Neuralink-class ambition, one-tenth the cost, zero surgery — a bidirectional brain-computer interface you could build for the price of a phone.

The costly signal

The measured result

Every number carries its own honesty tier — the tiering is the credibility.

£56

hardware for the EMG cursor path

 RESEARCH

3-in-1

EMG control · EEG read · PEMF stimulate

 RESEARCH

8

design reports written before code

 RESEARCH

The public conversation about brain-computer interfaces is dominated by one word: *surgery*. We wanted to know how far you could get **without** it — non-invasively, cheaply, and honestly — using science that has been in the literature for twenty years. This is an **open** report by design: the build belongs in the open, as a credibility-and-goodwill contribution, not a moat.

02 What it was



A **non-invasive, bidirectional BCI** for roughly **£500–£606**, combining three capabilities in one platform:

EMG-based cursor control — reading muscle signals to drive a pointer (about **£56** of hardware for this path alone).

EEG reading — sensing brain activity with consumer-grade hardware.

PEMF stimulation — writing back, gently, with pulsed electromagnetic fields.

The animating thesis, drawn straight from the published work: the **motor system is a peripheral bus the brain will learn to drive**, so a "virtual muscle" controlling a cursor *becomes*, to the brain, a muscle.

03 What we built



A **prototype and a rigorous design**, in that deliberate order:

Working **EMG finger-test code** on ESP32-S3 + ADS1299 hardware.

Eight council design reports written *before* code, with the IP filed *before* disclosure.



RESEARCH — MEASURED, PARTIAL

The measured, honest facts are about **cost and scope**, not a benchmark: a three-in-one, non-invasive, bidirectional device specified for the price of a phone, with a working EMG path proven on the bench. The claim we make carefully is *integration and price*, not a new sensor.

04 What we learned — including the honest edges

The novelty is the integration, not the science. Every underlying capability is grounded in decades-old, cited neuroscience (Carmena, Schwartz, Hochberg). The contribution is combining them, non-invasively, at this price — and being explicit that we did not invent the physics.

A prototype is not a product. Working EMG code is real; the fully integrated three-in-one device is not built yet, and we do not imply otherwise.

Stimulation is safety-serious. Writing to a brain, even gently with PEMF, is not a toy — which is exactly why it was treated design-first, with reviews and IP before any disclosure.

05 Where it went / status

Held as an **open-hardware research prototype**. It sits at the sensing end of the lab's "waves, not pixels" thesis — capture the world as waves and feed it to a wave model — and it makes a wider point the archive keeps returning to: the hardware floor for owned, private intelligence is far lower than the surgical-implant headlines suggest.

What is still open — kept visible

The honest edges of this lane, shown next to the wins. None of these is a footnote; each is a claim we have not yet earned — and marking it is what earns the right to be believed on the rest.

- ☐ It is a prototype: working EMG finger-test code exists; the full integrated device does not yet.
- ☐ The novelty is the integration and the price, not the sensors — the underlying science is two decades old and cited as such.
- ☐ Neuro-stimulation (PEMF) is a safety-serious surface treated design-first, not a toy.

06 Sources, glossary & the ledger

Where every claim comes from — and what the plain words mean.

Sources

- 01 **Vocabotics project audit — BCI (EMG/EEG/PEMF, ~£500–606), Apr 2026** — Vocabotics internal project history (as of April 2026)
- 02 **Carmena et al., learning to control a brain–machine interface (motor cortex as a peripheral bus)** — the published neuroscience the design rests on (as of 2003)

THE HONESTY LEDGER

- Shipped — measured, gate-clean.
- 🔬 Research — measured, partial; the gap is shown.
- 🔭 Vision — designed, honest; not yet built.

The bigger claim goes up a tier, never down. We show the eval beside the demo — the tiering is the credibility.

See the other end of the device story

If AI can run on a 1982 computer and read from a £56 sensor, the hardware floor for owned intelligence is far lower than people assume.

[/lab/neural-net-on-a-zx-spectrum](#)

Nothing faked.

A real, dated lab report from our own R&D. Measured, not asserted; the honest negatives are kept on the page next to the wins — because a lab that hides its failures forfeits the right to be believed on its results.

