

A classroom tool for creative electronics

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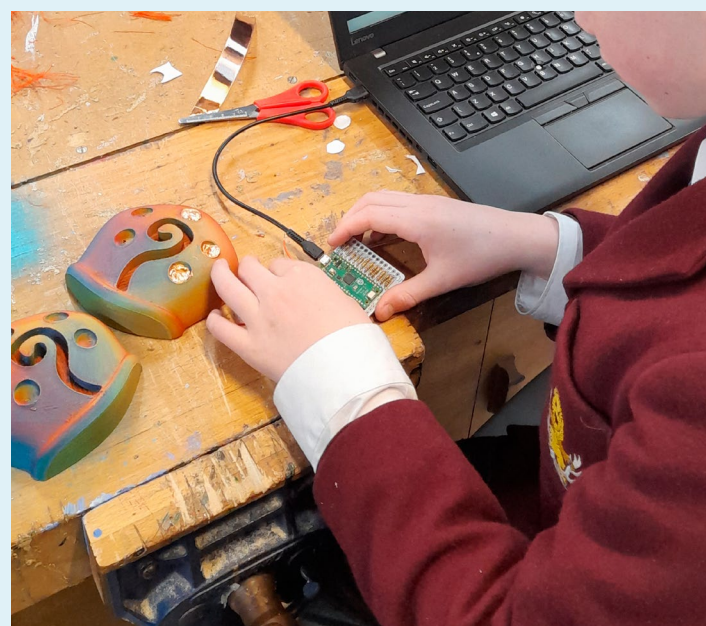


SPOKE is a classroom-developed capacitive touch controller that enables pupils to design and prototype interactive products with minimal technical barriers. Originating from a need to bridge the gap between idea and working outcome, it supports student-led projects that integrate electronics, coding and product design.

SPOKE did not start as a product. Every decision in its design came from classroom experience. Currently, in my D&T workshop at Beechwood Park, one pupil is building a birdhouse that plays birdsong when you touch it. Another is constructing their own MIDI oboe. A third is building a stenography machine, programming custom key combinations to produce shorthand characters at speed. A fourth is designing a custom games controller, editing code to map each input and housing the whole thing in a casing they designed and 3D printed themselves.

What is SPOKE?

SPOKE is a capacitive touch controller board I designed specifically for classroom use. The brief I give pupils is deliberately open: "here is what the board can do, now make something that is yours". What comes back has been more varied and more ambitious than I expected. In every project, pupils end up working across electronics, coding, product design, and whatever other discipline their idea demands. D&T, computing, physics, music technology, art, not as separate boxes, but as tools in the service of something they want to build.



From module to product

SPOKE started as a module. I began teaching a unit I had built around the Raspberry Pi Pico, using its capacitive touch capabilities to get pupils making interactive electronics projects. The Pico is brilliant, but using it raw in a classroom had issues: loose wires, breadboards that pull apart, components that are unsecured unless soldered, and then difficult to desolder. The gap between having an idea and having a working prototype was wide enough that some pupils never quite got there.

I designed a basic PCB that consolidated everything into a single board a pupil could solder together. It was rough, but it worked, and watching pupils use it made it clear there was something worth developing properly. This led to two designs: SPOKE, a round, fully built board based around the RP2040 chip, with 27 touch-sensitive inputs that you can crocodile clip to, NeoPixel LEDs, and expandable connections; and the SPOKE-mini, a solder-it-yourself kit for pupils who want to embed the hardware into a project.

Last year, I ran a successful Kickstarter campaign to fund the first proper manufacturing run. The boards are made in the UK by Pimoroni and will soon be available through their shop, a journey from classroom challenge to manufactured product that felt, appropriately, like the iterative design process I try to teach.

Designed for the classroom

The project was designed to remove as many barriers to access in the classroom as possible. The code is CircuitPython and lives on the board as a plain text file. To change what it does, pupils can simply open it in Notepad, edit, and save. No specialist IDE, no drivers, no compilation step.

Almost any conductive material works as a sensor: copper tape, conductive thread, fruit, or thick pencil lines on paper. We have found embroidery nails and electrical block connectors work brilliantly. Pupils design their own interface from scratch, which means the product design challenge is present from the very first lesson. SPOKE works as a USB-MIDI device (as well as a keyboard/mouse input) and is compatible with WebMIDI, meaning pupils can play their instrument through a webpage without any dedicated music software. No DAW licence, no specialist suite, a Chromebook is enough. It can, of course, work with full IDEs and DAWs too, but they are not essential.



Scaling across contexts

In the first year of pilot projects, Frazer Merrick has run music-making workshops with it at CLIP in Colchester with teenagers. Gawain Hewitt, who specialises in accessibility in musical instrument design, has used the boards in sessions for Wigmore Hall, the Tri-borough Music Hub, and the National Gallery. Natalie Whitney used SPOKE as part of the Overload project, running CPD with early years practitioners and co-creating interactive audiovisual work with children aged two to four.

At the other end of the age range, Professor Leah Kardos used SPOKE with final-year students at Kingston University on a module where students respond to a real industry brief, gaining experience of working with a client (me) while producing something professionally valuable. The same board, working at every level.

The moment of discovery

There is a moment when someone uses capacitive touch for the first time. They lightly touch an object, whether it is a banana, a bonsai tree made from wire, or a piece of copper tape. The computer makes a sound, their eyebrows lift slightly, and they let out a small "oooo".

This moment has been happening with my pupils here at Beechwood Park as they build their touch-based projects. It is a wonderful sound. It is often followed by, "Let's see if this would work," which quickly develops into an idea, then a design, then a prototype.

If you are a D&T teacher looking for a project that connects electronics, computing, art, and science, get in touch. I am keen to work with more schools to develop resources and support around it.



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THE SPOKE BOARD WEBSITE**
tinyurl.com/yuez74ye