

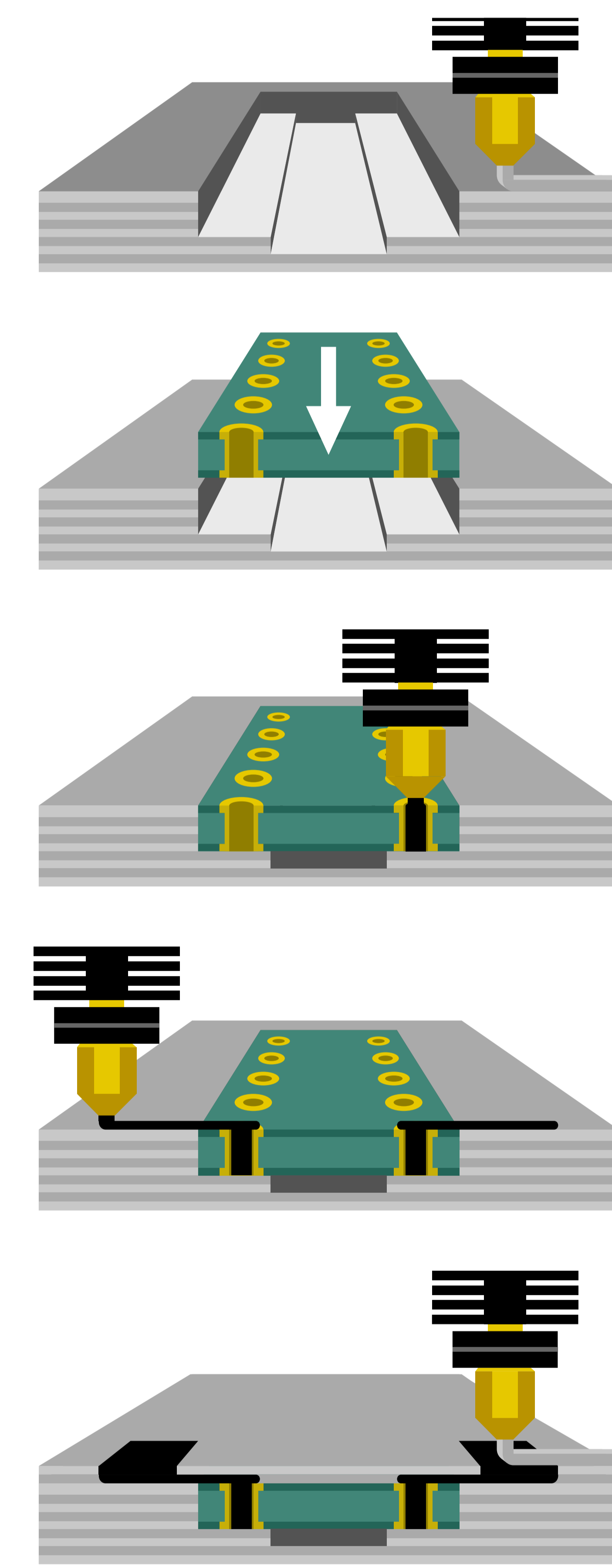
Printegrated Circuits: Towards 3D Printed Scalable High Fidelity Interactive Objects



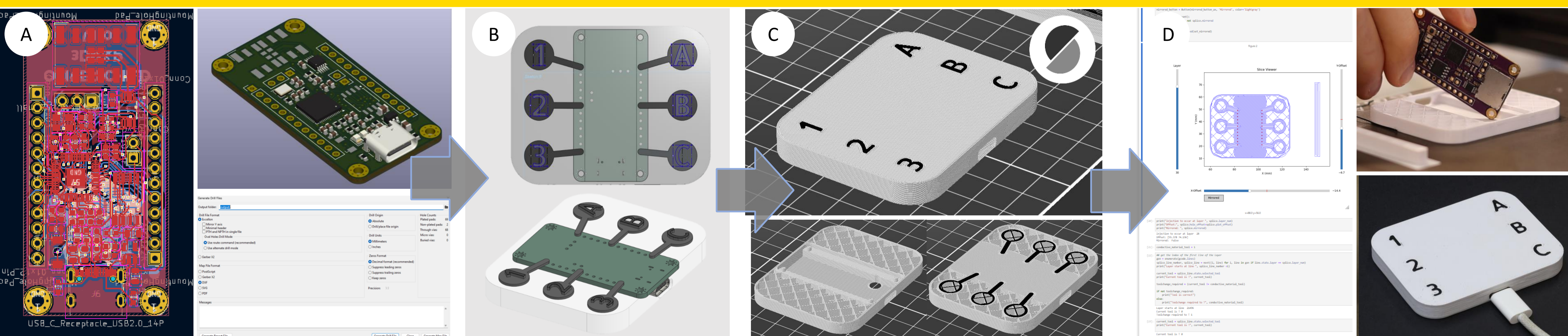
Printegrated prototypes printed on FDM PrusaXL 3D printer, from left to right: Capacitive shape game detects last picked up polyhedron, Wireless smart lamp uses wireless charging and addressable LEDs, Force sensitive haptic input controller

Abstract

3D printing enables rapid prototyping and production of static objects at the medium scale, enabling customizability and local production. Responsive devices that include electronic circuits for feedback and interaction on the other hand either exist as stand-alone circuits, bespoke crafted and fragile prototypes, or final products that must be produced in large quantities to be viable. We present *Printegrated Circuits*, an approach to embed PCBs into 3D printed parts during the printing process and add interactivity through conductive material enabling capacitive and resistive sensing and embedded on-PCB haptics and lighting. By democratizing access to high-fidelity device fabrication with accessible tools, we believe *Printegrated Circuits* can help unlock the long tail of interactive hardware production.



Custom G-code scripts instruct multi-material FDM 3D printers to allow for manual insertion of PCBs and *prinject* conductive filament into through holes ensuring stable electrical connections



Printegration: (A) Designing custom development to be embedded in (B) a multimaterial 3D print which undergoes (C) traditional slicing before (D) G-code post-processing with original electronics files for PCB insertion.

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Vision

We have demonstrated the potential of *Printegrated* circuits in several demonstrations using both off-the-shelf prototyping PCBs with wireless capabilities and our own custom board with capacitive input and haptic feedback. We are seeking to develop the next generation of general purpose *Printegration* PCBs combining these capabilities and being specifically designed for the process. High fidelity *Printegrated* prototypes can then be deployed in wider settings than traditional HCI prototypes where robustness, customisability, and scalability need to be combined with electronics.