MakeDevice: Evolving Devices Beyond the Prototype with Jacdac

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Motivation

- Embedded hardware is common

- Prototyping new embedded hardware is easier with toolkits like Arduino[1], micro:bit[2] and Jacdac[3]

- Moving beyond a prototype can be *costly* and *complex*[4]

- A "long-tail" of potential devices never reach their full impact[5]

- Can we make the transition from prototype to delivery easier?

Contribution

MakeDevice: A web-based tool that leverages the Jacdac prototyping platform, enabling an end-to-end workflow from a wired desktop prototype to a robust, enclosed device with modules electrically connected via a carrier PCB.

Key features:

- Jacdac modules attached to the PC are automatically detected, arranged on a carrier PCB and electrically routed

- Intuitive drag and drop interface lets users (re)arrange modules

- Automatic generation of Gerber files from the final arrangement, suitable for online PCB fabrication services without modification.

- Various enclosure options are presented to the user, **MakeDevice** automatically generates STL files for 3D printing and SVGs for laser cut press fit boxes or stencils
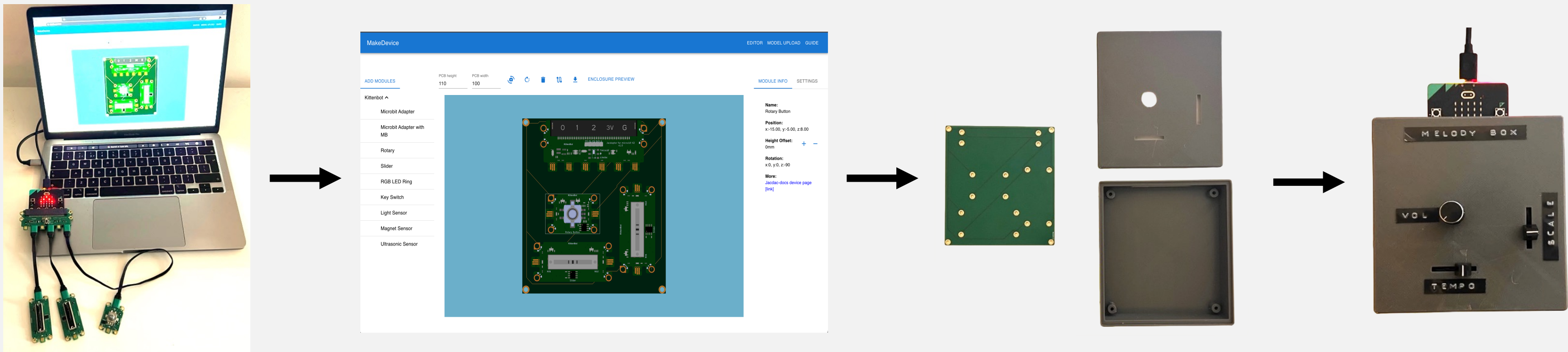
Workflow Overview

Carrier PCB Generation

Enclosure Stencils

Future Work

- User evaluation, exploring the value of **MakeDevice** for various stakeholders: industry, research and home innovators

- Seamless upload of Gerber files and BOMs to PCB fabrication services

- Modification of existing off-the-shelf enclosures to support environmental deployment

- Integration with embedded hardware programming for a complete low-code workflow

- Exploring 3D digital twins of Jacdac modules, reflecting state of Jacdac modules connected in modules shown on screen

References

[1] Arduino 2021, arduino homepage. https://www.arduino.cc **[2]** Jonny Austin, Howard Baker, Thomas Ball, James Devine, Joe Finney, Peli De Halleux, Steve Hodges, Michał Moskal, and Gareth Stockdale. 2020.The bbc micro:bit: from the u.k. to the world. Commun. ACM, 63, 3, (Feb. 2020), 62–69. doi: 10.1145/3368856. **[3]** J. Devine, M. Moskal, P. de Halleux, T. Ball, S. Hodges, G. D'Amone, D. Gakure, J. Finney, L. Underwood, K. Hartley, et al. Plug-and-play physical computing with Jacdac. Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 6(3):1–30, 2022. **[4]** R. Khurana and S. Hodges. Beyond the prototype: Understanding the challenge of scaling hardware device production. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, CHI '20, page 1–11, New York, NY, USA, 2020. **[5]** S. Hodges and N. Chen. Long tail hardware: Turning device concepts into viable low volume products. IE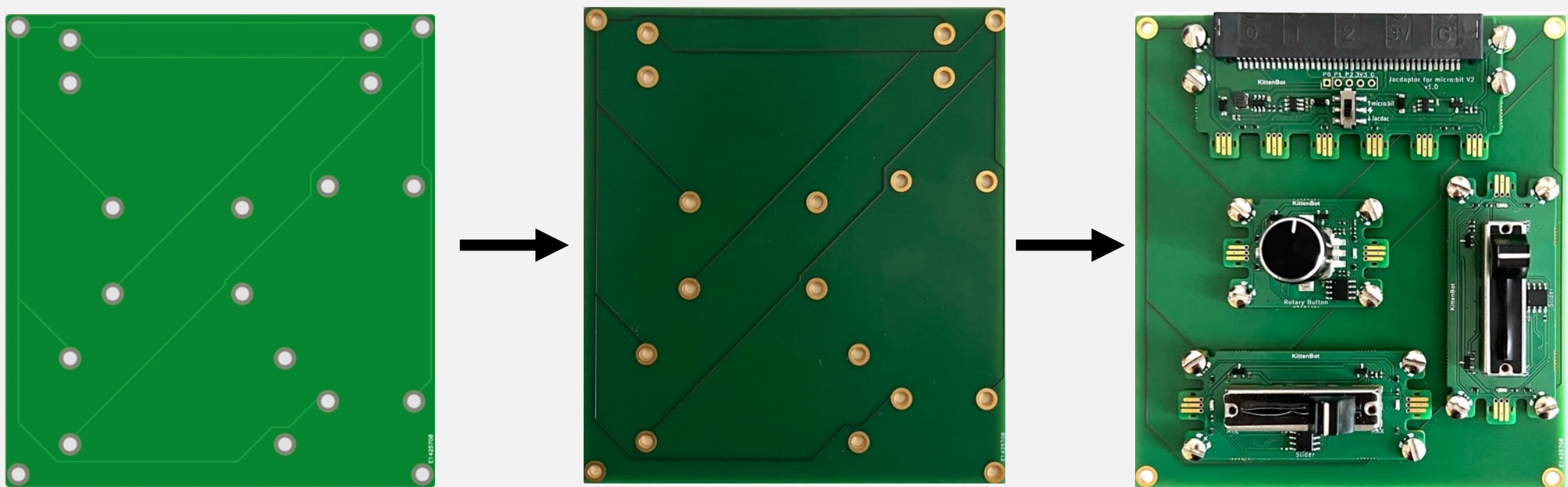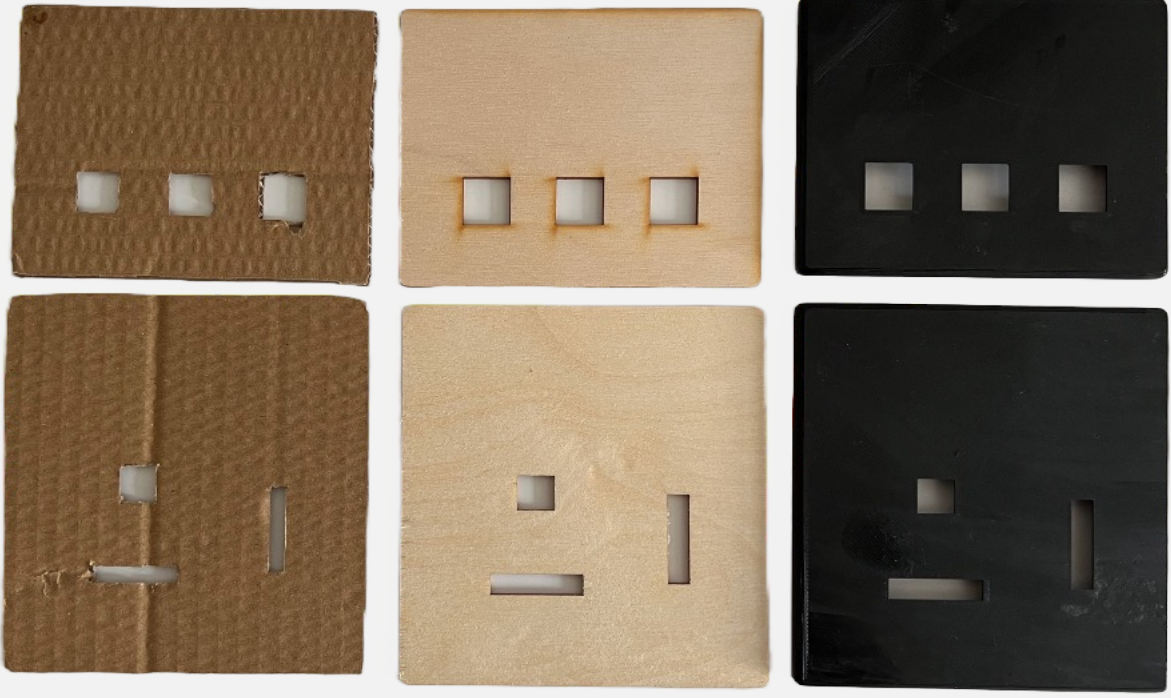EE Pervasive Computing, 18(4):51–59, 2019