Enabling Non-Technical Users to Create Customised Hardware Through Automated Tools

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The increasing demand for customised devices, particularly in accessibility and gaming, underscores the need for such solutions; however, many users lack the technical skills required to create their own hardware solutions. Automated tools for non-technical users can bridge this gap by empowering novice designers and lowering the technical barriers to entry in hardware development, thereby enhancing accessibility and promoting user-centred design. Using game controllers as an example case study allows us to explore how automated design tools can lower costs, increase user adoption, and foster a more inclusive hardware community.

CCS Concepts: • **Hardware → Electronic design automation**; • **Human-centered computing** → *Interaction devices.*

Additional Key Words and Phrases: Open-source hardware, Automated design tools, User-centered design

The increasing demand for individualised hardware, particularly in areas such as gaming and accessibility, highlights a growing challenge: many users require personal solutions but lack the technical skills required to create them. I propose that automated tools designed for non-technical users are a critical path to bridging this gap. Rather than expecting each individual to learn complex hardware design and troubleshooting, we can empower them with systems that efficiently generate user-tailored hardware, with minimal need for skilled oversight.

Individualised hardware has the potential to improve comfort, usability, and mechanical efficiency, while also driving accessibility, enhancing user experiences in ways that generic solutions cannot. While the effects on user agency and ownership remain underexplored, providing automated design tools allows users to transition from being passive recipients of pre-designed devices to novice designers contributing to their own customised solutions.

My particular focus is on game controllers, a domain where DIY approaches, "hacked" devices, and expensive bespoke solutions dominate because of the industry's prevalent 'one-size-fits-most' approach. Automated design tools in this space would lower the barrier to entry, making customised hardware affordable and more widely adopted. By exploring frameworks and tools that enable non-technical users to design and build their own hardware, we can democratise the hardware design process in this field and foster a more inclusive and collaborative hardware community.

My prior work has directly engaged with these challenges, as I have developed a customised controller solution for a disabled gamer[1] and created a tool that significantly accelerates the layout design process[2]. I am currently building a system that allows users to design and test controller layouts virtually, alongside a parametric toolchain that translates layout data into automatically generated PCBs and enclosures. Through this work, I have encountered key friction points from the complexity of designing for individual needs to the limitations of automation, especially where embodied experience resists full abstraction. These insights inform my interest in developing frameworks that balance automation with meaningful user agency.

This approach aligns with the workshop's goals: to consider how hardware knowledge is shared, explore mechanisms to increase accessibility, and create frameworks that enable both technical and non-technical participants to meaningfully contribute to hardware innovation. I am excited to collaborate with other participants to map knowledge, share experiences, and explore practical tools that make user-driven, bespoke hardware creation feasible and widespread.

[1] https://github.com/jackjburnett/JBMK-Controller
[2] https://github.com/jackjburnett/VirtualLeverless

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