Gigswitch: Rethinking the Physical Form of Guitar Pedals Through Configurable Hardware

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Abstract*—This paper presents Gigswitch, an open-source loop-switching platform built to explore different ways of constructing and interacting with guitar pedals. The current prototype combines relay switching, configurable peripherals, and ESP32-based control hardware intended for custom enclosure development and small-scale experimentation with alternative pedal forms.

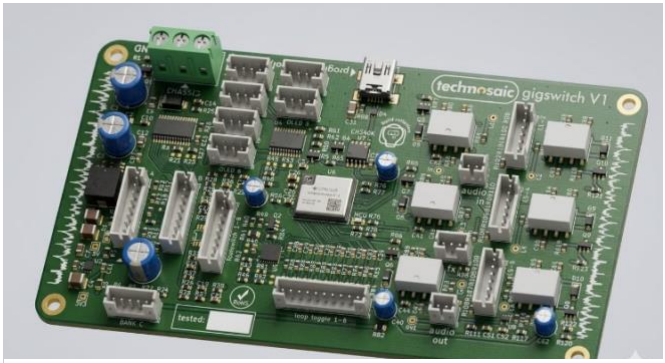

Figure 1: Rendered view of the current Gigswitch prototype PCB

I. Introduction / Background

Guitar pedals offer a wide range of sonic experimentation, yet their physical form has changed very little over time. Most modern pedals still rely on folded metal box-shaped enclosures, largely due to ease of manufacture, durability, and EMI shielding. Because of this, experimentation in pedal culture tends to focus on sound and pedal combinations rather than the physical design of the devices themselves.

Desktop 3D printing and other digital fabrication tools have made personalised product design far more accessible. Even with these developments, most guitar pedal systems still depend on traditional enclosure formats, limiting opportunities for unusual physical layouts or personalised ergonomics.

Gigswitch explores whether configurable loop-switching hardware can be used as a foundation for alternative enclosure designs. Rather than treating the enclosure as a fixed protective shell surrounding a circuit, the project investigates how embedded hardware and digital fabrication can support different physical forms while remaining compatible with existing pedals and live performance workflows.

A. *Pedalboard Culture*

The electric guitar uses magnetic pickups to convert string vibration into an electrical signal, often routed through a chain of effects pedals that shape tone, texture, and performance style. In guitar culture, pedals are closely tied to personal identity, with certain effect combinations commonly associated with genres, influences, or ways of performing. Signal chain arrangement also becomes highly personal over time, with players often developing strong preferences around ordering and control.

Loop switchers are used to organise effects into programmable signal groups. This reduces the need for performers to manually activate multiple pedals during live performances (commonly known as tapdancing), allowing musicians to toggle between larger effect combinations with fewer switches. They act as an organisational layer between performer and pedalboard, making repeated switching actions easier to manage when playing.

Even though modern pedals can produce a huge variety of sounds, their physical structure remains largely standardised. Most pedals continue to use enclosures shaped by existing manufacturing methods and pedalboard conventions. While these enclosures provide durability and electromagnetic shielding, they also reinforce a relatively narrow range of stompbox shapes and layouts.

As a result, most experimentation within pedal culture still takes place through circuitry and signal processing rather than through the enclosure design itself.

B. *Hardware as Creative Framework*

Most guitar pedals are designed as fixed-function devices, where each performs a specific role within a larger pedal chain. As pedalboards expand, musicians often end up with multiple pedals that perform very similar or overlapping functions. While this model encourages experimentation through mixing combinations, the hardware itself usually remains fixed once manufactured.

Several open hardware projects have explored alternative approaches based on reconfiguration and programmability. The pedalSHIELD UNO project *(figure 2),* developed by ElectroSmash, used a microcontroller-driven digital signal processing (DSP) approach. Rather than relying exclusively on analogue circuitry, incoming audio signals are digitised, processed through software, and reconstructed at the output stage. This allows different effects to be loaded via firmware rather than changing the underlying hardware.

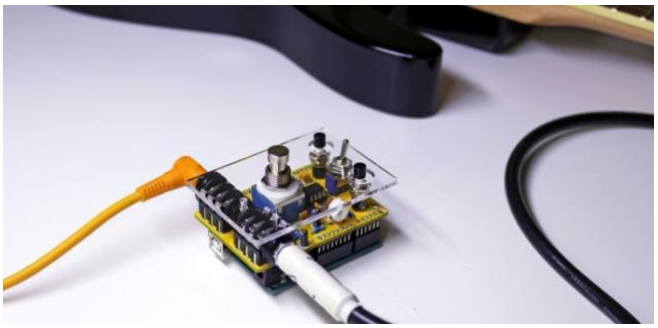

Figure 2: pedalSHIELD UNO by ElectroSmash, an open hardware DSP guitar pedal platform [1].

Gigswitch explores a related idea of reconfiguration but shifts the focus toward switching infrastructure and hardware organisation. Instead of replacing the behaviour of existing pedals, the project investigates how configurable switching hardware can operate as a reusable platform for different pedalboard setups and control arrangements.

This approach is also influenced by other modular hardware systems used in creative projects, including custom pinball machine development. Frameworks such as those developed by FAST Pinball provide configurable hardware that allows designers to build highly personalised interaction systems around a shared core platform [2]. Similar principles are applied within Gigswitch, where the intention is not to prescribe a final form but to provide a reimaginable hardware toolkit.

C. ***Prototype Architecture***

The hardware operates from a standard 9V pedal supply commonly used across guitar equipment. The current prototype is built around Espressif's ESP32 microcontroller [4], as it offers strong existing support, are widely available from electronics vendors – offering wireless connectivity, and a broad range of built-in peripherals (*figure 3).*

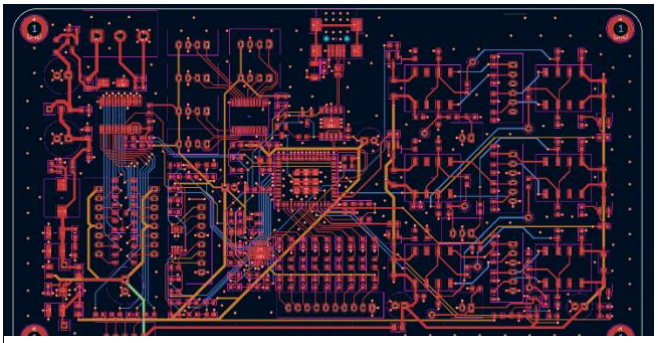

Figure 3: Four-layer Gigswitch PCB layout showing relay switching and peripheral expansion design.

The switching system currently supports six true-bypass relay loops alongside an additional effects loop that can be used for preamp stages or external processing chains. A dedicated mute stage is also included at the output to reduce audible mechanical switching noise during operation.

Several configurable input and output headers are included across the PCB for external peripherals and interface components. Six I2C expansion ports allow devices such as OLED displays to present loop names or status information. These ports are multiplexed to avoid address conflicts when multiple peripherals are connected simultaneously.

Footswitch inputs are connected through dedicated hardware interrupt lines to improve responsiveness during use. Additional user buttons and configurable LED banks are included for preset selection, loop indication, and interface feedback.

D. ***Material & Enclosure Considerations***

Consumer pedal enclosures are typically constructed from folded metal due to durability requirements and electromagnetic shielding. The conductive enclosure acts as a Faraday cage, reducing susceptibility to external electromagnetic interference and radio frequency noise that may otherwise enter the internal audio signal path.

To support a non-metal enclosure, Gigswitch separates shielding functionality from the enclosure structure itself. An accessible chassis grounding terminal allows conductive foil *(figure 4)* to be connected directly to circuit ground *(figure 5)*. This enables non-metal enclosures, including 3D-printed forms, to retain shielding behaviour without relying on fully metal housings. Commercial projects such as *Danger of Death*, created by *4D PEDALS* have already demonstrated success in 3D-printed guitar pedal enclosures and alternative pedal aesthetics *(figure 6).*

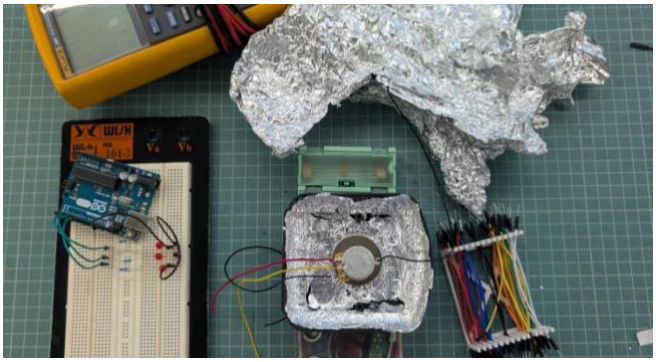

Figure 4: Early aluminium foil shielding experiment investigating non-metal enclosure grounding approaches.

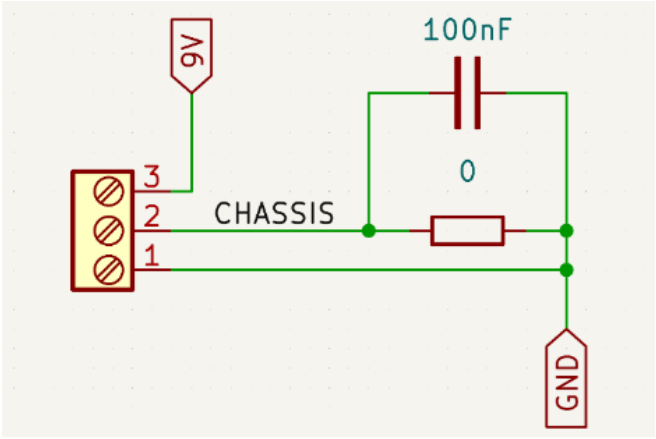

Figure 5: Chassis grounding implementation used to support conductive shielding layers.

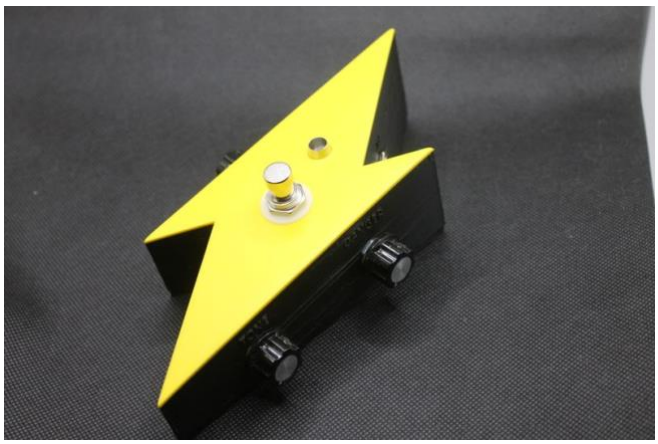

Figure 3: "Danger of Death" guitar pedal enclosure produced by 4D PEDALS using 3D printing techniques [3].

II. Responsible Innovation

Gigswitch is being developed as an adaptable hardware platform intended for longer-term use rather than as a fixed-function device. Traditional pedal systems often encourage the accumulation of multiple specialised devices, many of which contain overlapping functionality or limited opportunities for modification once manufactured. By separating switching infrastructure from enclosure construction, the project aims to support continued reuse and modification without requiring complete hardware replacement.

Desktop 3D printing is being used throughout development as a practical method for prototyping enclosure concepts and producing small batches of parts without dedicated tooling. Although additive manufacturing introduces its own environmental considerations, producing and modifying parts locally during development avoids repeatedly manufacturing complete metal enclosures while testing design changes.

The project is also intended to remain openly accessible throughout development. Firmware updates can be applied directly over USB without specialist programming hardware, allowing the system to be modified, repaired, or adapted more easily over time.

III. Author Bio(s) / Experiences

I am a creative technologist practitioner working for Newcastle University, where I manage Open Lab's makerspace facility. My work typically involves solving technical problems for students and academic researchers, drawing on digital manufacturing, electronics, and embedded software to support a wide range of research projects.

Professional Bio: Ben Morris | Open Lab

My interest in the relationship between people and technology developed through previous work as an exhibit designer, alongside undergraduate and postgraduate studies in Product Design. Gigswitch was jointly inspired by my interest in musical equipment and in how alternative hardware systems can support broader forms of design experimentation.

I have recently been involved as a lead designer on an RtD project called *Resound*, which resulted in four publications over a two-year period exploring prototyping for religious practices [5].

E. *Refrences*

[1] ElectroSmash, "pedalSHIELD UNO." [Online]. Available: ElectroSmash pedalSHIELD UNO

[2] FAST Pinball, "FAST Pinball Hardware Platform." [Online]. Available: FAST Pinball

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[5] C. Claisse, D. Chatting, S. Wolf, B. Morris, and A. C. Durrant, "Resound: A Moment of Reflection in a Techno-Spiritual RtD Inquiry," *Proceedings of the Nineteenth International Conference on Tangible, Embedded, and Embodied Interaction*, 2025. [Online]. Available: Resound: A Moment of Reflection in a Techno-Spiritual RtD Inquiry | Proceedings of the Nineteenth International Conference on Tangible, Embedded, and Embodied Interaction