An Open Audio Processing Platform using SoC FPGAs and Model-Based Development

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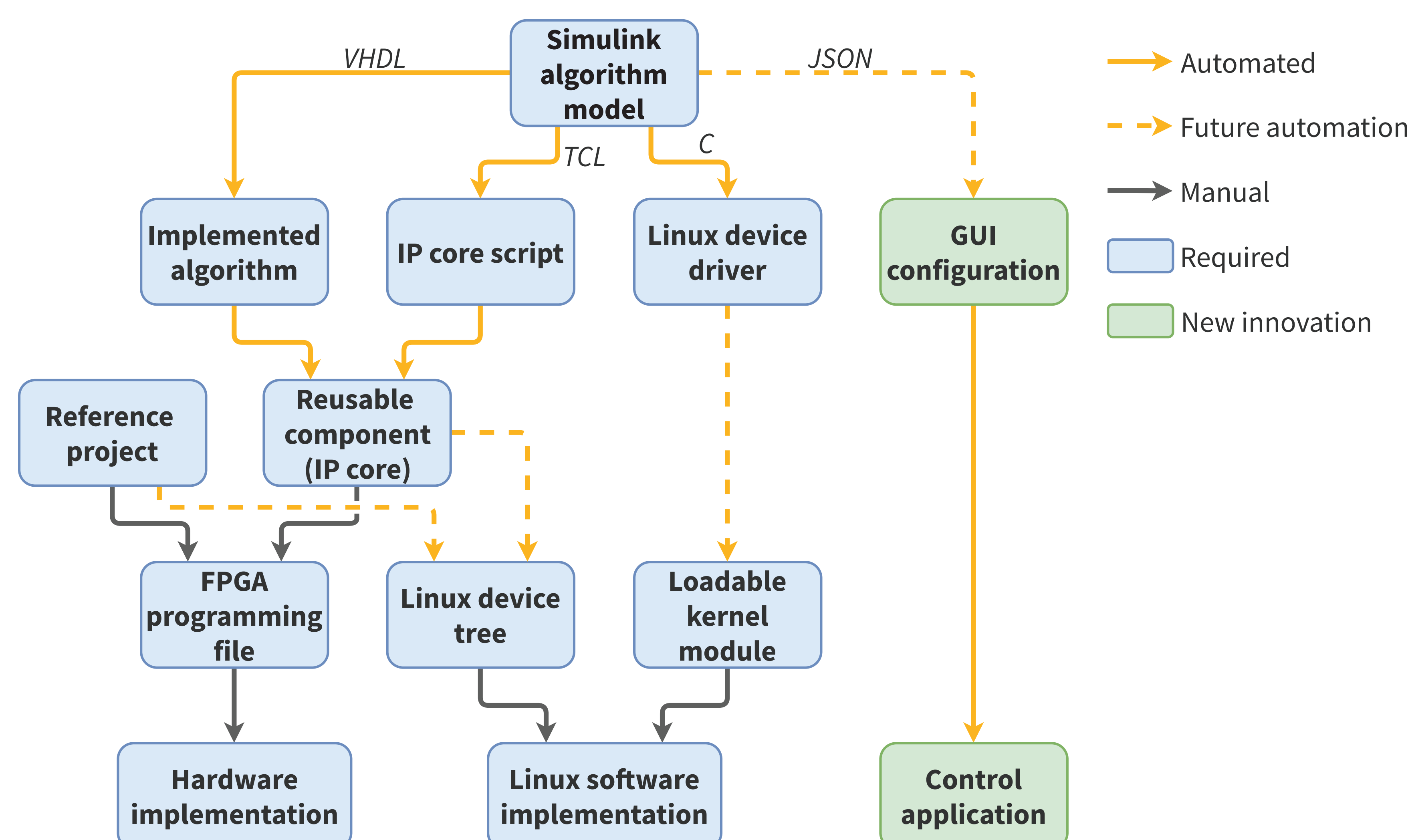## Streamlining the creation of low-latency FPGA-based signal processing applications

- System-on-Chip (SoC) Field Programmable Gate Arrays (FPGAs) are ideal for low-latency signal processing

- Automated, model-based development process makes FPGAs more accessible

- Open source hardware facilitates real-world testing

Why Use Soc FPGAs?

- Lowest latency signal processing
- CPU performance is stagnating
- FPGA performance continues to scale
- Linux software ecosystem
- Algorithms can be hardware accelerated
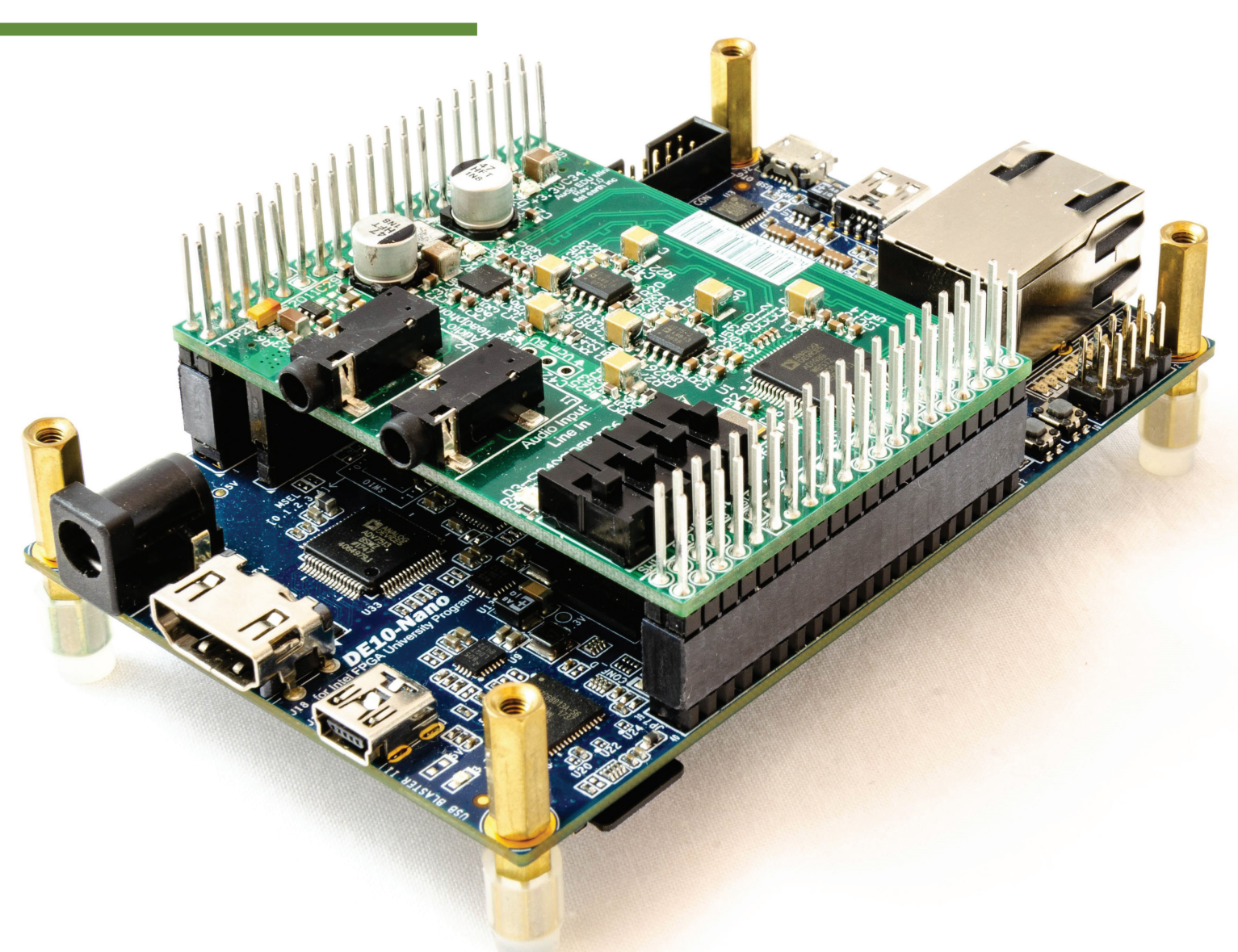
Development Process

- Typical workflow is time consuming

- Model-based development and automatic code generation decrease development time and increase accessibility

- Eliminates the need to know FPGA programming languages

- Creates control application

Sound Effects Processor

- Programmable effects chain

- Hardware is controlled by a GUI application

SoC FPGAs contain a complete computer system known as the Hard Processor System (HPS) as well as the FPGA "fabric" that is composed of various types of logic blocks. The FPGA fabric allows the creation of custom hardware.


Flow diagram of our development process. The blocks in blue are required to have a functioning system; these steps are typically done manually in most development workflows. The blocks in green are not typically included in standard SoC FPGA development workflows. The arrows highlighted in yellow are automated in our workflow. The languages needed for each step are indicated next to the arrows.

Open source hardware platform comprising a DE10 Nano development board and a Flat Earth Audio Mini daughter card.
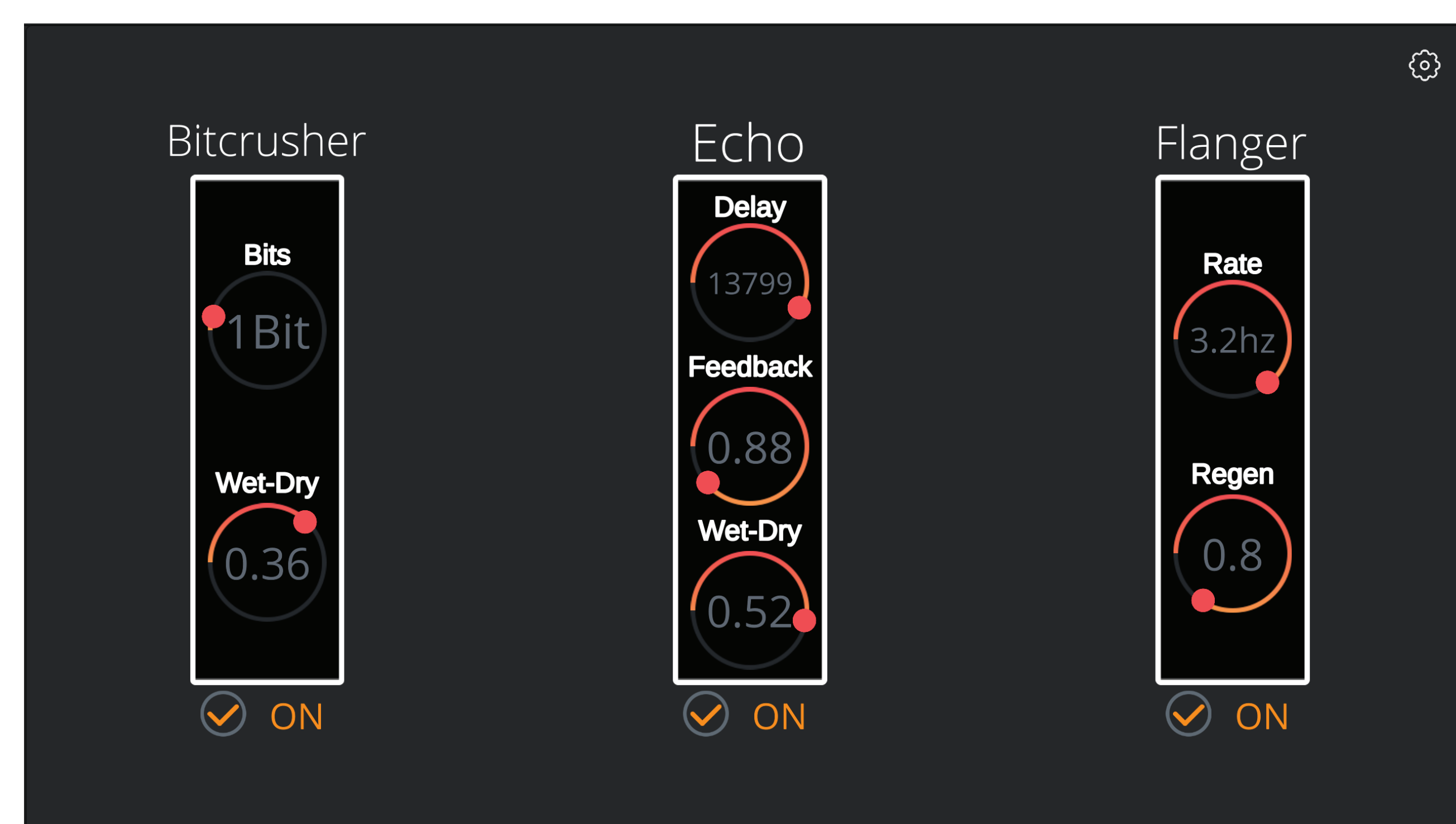
An example of the sound effects processor GUI. This example shows a simple bitcrusher, echo, and flanger, each of which can be disabled.

Future Work

- Automatically generate GUI configuration
- Higher performance hardware platform

Acknowledgments

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