Project Proposal

Atomic Tangerine | Sep 28, 2021

Project Goals

This project aims to develop a communication system, audio hardware, and software interface for professional audio devices. The software will be able to control device parameters and visualize sound information from the device using a communication protocol and computer-based signal processing. The overall system will be modular and expandable; permitting new designs by pro-audio equipment makers to utilize the standard. The GUI, standard, and a prototype device will be produced by April 2022.

Background

In today's audio production landscape, there's a divide between analog and digital audio processing. Analog devices provide superior sonic quality and are thus preferred by well-financed studios, while digital devices are easier to control, cheaper, and more user-friendly. Introducing a standard for digital control of analog equipment will improve the experience of those who use a hybrid digital/analog recording and mixing workflow. Digitally controlling analog equipment will also reduce the gear's maintenance requirements and cost, which is the main barrier for entry for analog audio equipment.

The current market for digitally controlled outboard gear consists of several contenders, each with their own proprietary communication standard, including WesAudio, Solid State Logic (SSL), and others. The closed nature of these standards, combined with the fact that recording studios typically have equipment from many manufacturers, results in a significant need for a modular standard.

Challenges and Risks

Our team needs an effective data path to interface our device with a Digital Audio Workstation (DAW). We have chosen USB, which has extensive specifications we need to understand to maximize the bandwidth we use. We need to determine how many devices can be handled, data bandwidth, and connection latency. Hardware costs propose another challenge; the total funds provided by Tufts is 200-500 dollars. Certain EQ designs contain many expensive components, which we need to balance against our budget.

We also aim to visualize our data. The ADC will digitize analog audio output, which we can use with classical digital signal processing algorithms to create spectrograms, bode plots, and other audio visualization. Transmitted data must have a small enough bandwidth to be transmitted quickly over USB, yet enough resolution to provide helpful visualizations. Additionally,

software controls need to be represented graphically and have seamless control between digital and physical.

Scope

Software

The device(s) will be controlled using a GUI which conforms to a known plug-in standard (VST/AU/etc). The GUI will be able to meter and visualize device data in both time and frequency domains, allowing users to easily understand the audio devices. Data to generate the user interface for each device type will be stored in the GUI. The GUI will have user-programmable presets which can be recalled to the device.

Communication System

The network will use USB and permit the maximum number of devices possible. Devices should be able to be daisy-chained together. The communication system should be able to connect to a computer using USB protocol. Devices will have unique IDs to enforce communication standards.

Hardware

We will build a parametric gyrator-based equalizer (EQ). The device will have ADCs for metering and DACs for voltage control of the device. Our device will have front panel control (knobs, encoders, switches) to ensure that parameter values can be synchronized effectively.

Relevant Knowledge

To implement this project, we need to understand analog circuit design for parametric EQs, embedded system design, software GUI development, digital signal processing, as well as broad background knowledge in mixing and music.

Ethics

The device must be safe for consumer use, and not risk injuring or shocking the user. Additionally, materials chosen may negatively impact the environment or come from unsafe labor practices.

Criteria for Success

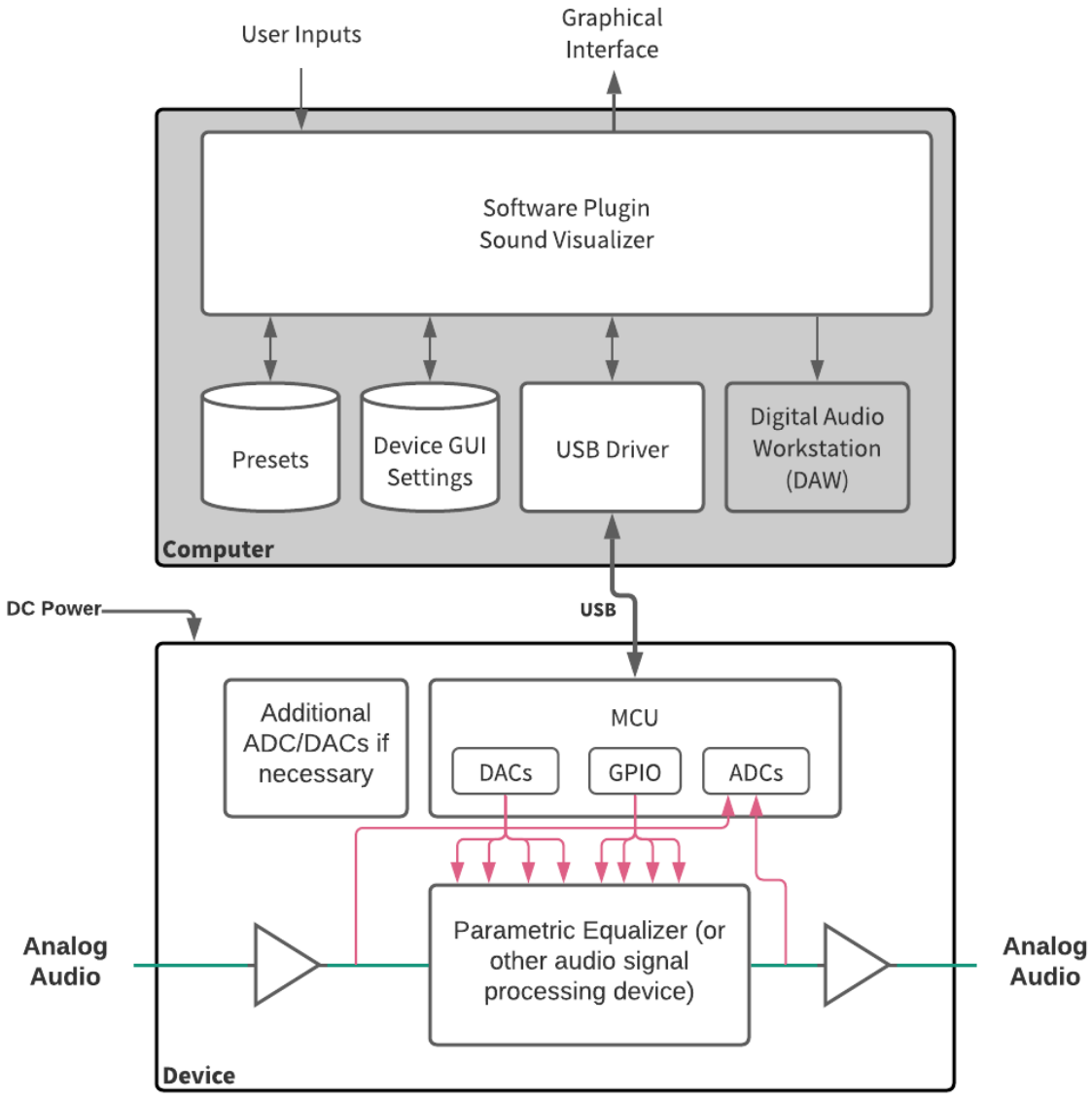
1) A working parametric equalizer for 4-5 signal bands, costing under 500 dollars, able to visualize audio data
2) A working communication bus that supports multiple devices
3) A software plug-in to control connected devices with a GUI
4) Satisfactory audio quality

Team Contract

- If you know that you will have a conflict with a meeting or deliverable let the team know as soon as you know.
- Treat each other and each other's ideas with respect.
- Every two weeks the "team leader" will shift and that person reminds and makes sure all the deliverables needed to be turned in during their tenure are turned in on time.

Figures

Figure 1: High Level Diagram



References

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Discussions with Ken Hirsch/Orphan Audio, Aug 2021-Sep 2021