AUDIOLINK

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CSUF COLLEGE OF Engineering and Computer Science

ECS STUDENT PROJECT Innovation Expo 2025

Project Background

Musicians performing live often face the challenges of adjusting audio effects in real time, especially when using multiple instruments. Traditional effect units are often limited in flexibility, require manual adjustments, or lack centralized control for an entire setup.
AudioLink addresses this problem by combining real-time digital signal processing and a unified control interface into a single, compact system. AudioLink enables a band to wirelessly control audio settings for two guitars and two MIDI controllers from a Raspberry Pi 5 touchscreen.
This project integrates hardware, firmware, audio processing, and user interface design to provide intuitive and centralized effects management system for live performances. Designed with flexibility, speed, and real-world usability in mind.

Problem Statement

Motivation for the project
The motivation behind *AudioLink* was to create a simple, all-in-one device that allows a band to change the frequency and effects of two MIDI instruments and two guitars in real time. It offers an efficient way to adjust audio effects such as EQ, reverb, bass, and delay — whether at home, in rehearsal, or during a live performance.
What problem are you solving?
Musicians worldwide often rely on multiple devices and software plugins to shape and manipluate their sound in real time, Which creates a complex fragmented system with a high latency. Audiolink solves this by offering and all-in-one, plug and play device that combines real-time audio frequency manipulation with an integrated touchscreen.

Goals and Objectives

What product is the team creating to solve this problem?
The team is creating *AudioLink*, a real-time audio processing device that allows users to control and modify the frequencies and effects of two MIDI inputs and two guitar inputs, through a single integrated interface.
We have numerous high-level features such as:
- Dual Guitar and Midi Inputs
- Real-Time Frequency Manipulation
- All-in-One Hardware Platform
- Embedded System Design

State what makes the product innovative
AudioLink eliminates the need for complex, multi-device setups

Design Requirements/Specifications

Functional Requirements:
- The system must support real-time audio effect control for 2 guitars and 2 MIDI instruments.
- Users must be able to adjust effects from a touchscreen GUI.

User Experience Requirements:
- The GUI must support fast, intuitive interaction using knobs and toggle buttons.
- Each instrument tab must be clearly labeled and responsive.
- The system should be plug-and-play, requiring minimal setup for a live gig.

Methodology

The system uses four Teensy microcontrollers, each assigned to a specific instrument (MIDI1, MIDI2, Guitar1, Guitar2). The two guitar signals are routed through dedicated preamplifier modules before entering their respective Teensy boards for real-time digital audio processing.

MIDI1 and MIDI2 controllers connect via USB MIDI host modules, allowing the Teensy boards to receive MIDI signals directly.

A Raspberry Pi 5 with a touchscreen provides a central control interface. All parameter adjustments are sent over a CAN bus network, enabling real-time control of effects like delay, reverb, chorus, distortion, and mix levels.

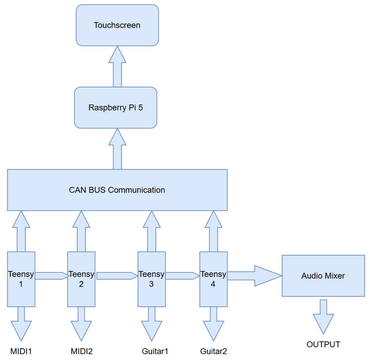
Processed audio signals from each Teensy are routed to an external audio mixer, which outputs a combined live mix.

Teensy 4.1

Preamp Module

Audio Mixer Module

CAN Bus Module



Acknowledgments

We would like to thank CSUF ECS, faculty advisors, collaborators, …

Project Mentor(s)

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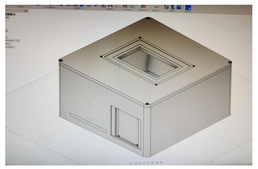
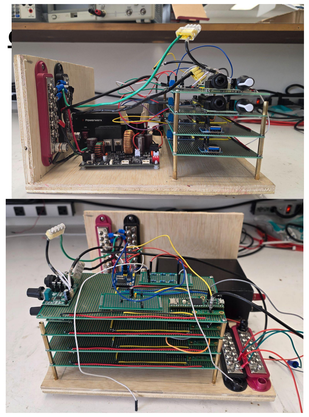
Results and Outcomes

GUI Design:

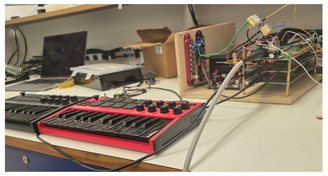
3D Model Design:



System Prototype #1:



Instrument Testing:



Summary

What did the team accomplish?
The team has successfully developed a functional prototype of *AudioLink*, this device is capable of real-time audio processing and is capable of handing two MIDI and two guitar inputs with low latency.
How did the prototype meet the Requirements:
Throughout the design and building of the prototype, the team identified the hardware and software requirements necessary to support live frequency and effect manipulation. Through the usage of Raspberry pi 5, multiple Teensys 4.1 boards, custom PCBS, preamps, and a touchscreen interface.

Future Directions

- Finalize the details to the 3d model.
- Add live looping capabilities.
- Integrate additional audio effects.
- Optimize audio quality for professional use.
- Polish audio effects.
- Support of other instruments such as Bass guitar.