

Improving Synth, Sample Features, and UI Interactivity in Music Blocks with Tone.js and D3.js

Sugar Labs - Music Blocks

Google Summer of Code

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Resume: [Google Drive Link](#)

Time zone: Eastern Standard Time (EST)

Sugar Labs Contribution:

- Music Blocks PR #4579 - [Refactor instrument selector to grid layout](#)

Why am I passionate about Music Blocks?

I strongly believe that other online resources and platforms like YouTube have immense potential to transform the entire education(not just academic) sector. However, despite their availability, I've noticed that education hasn't changed as significantly as it could have. I am deeply passionate about bridging this gap by harnessing the vast resources of the internet combined with advancements in AI to customize knowledge to individual learning styles. This personalized approach could profoundly enhance education, even surpassing the valuable experience I currently have at a prestigious institution like Villanova University, where I benefit from exceptional professors. Despite their excellence, much of

my learning still relies heavily on online resources. My journey with computer science illustrates this clearly—I learned various programming languages through YouTube tutorials and practiced extensively using platforms like LeetCode.

Similarly, my passion for music and performing arts began in kindergarten, when I first took part in a completion (p.s. I watch that recording every summer, it's amazing). When I first attempted to learn piano in fifth grade, the nearest music classes were five miles away, making it difficult for me to continue beyond a month. I tried to learn piano again in seventh grade through online tutoring, but it proved to be expensive, limiting my ability to continue. I searched extensively for free online resources, but quality content was often inaccessible without significant costs. By contributing to Music Blocks, my goal is to enhance its functionality so music education becomes accessible to everyone, eliminating the barriers of costly coaching and enabling free, high-quality online learning.

My Coding Journey

I have been coding for more than six years. I started by learning the basics of DSA in Java and then moved on to learning web development. It began with basic HTML, and I gradually expanded to full-stack development using the MERN stack and other languages. As you can see from my resume and GitHub, I have some full-stack experience.

Last summer, I interned at EY as a Tech Consulting Intern, where I enhanced ERP backend integrations through SAP. Since the start of this spring semester, I have been involved in research. One of my projects involved AI-driven market sentiment analysis, where I built an AI model to track market sentiment. With all this, I still regularly practice my DSA with Leetcode.

Although I am relatively new to open source, I have already learned a lot. The idea of working with large datasets and coding collaboratively is exciting, and so far, it has been a rewarding learning journey.

Project Goals

This project aims to improve both the UI and audio functionalities in Music Blocks. It will be conducted in two stages- one smaller and one larger:

- **Stage 1:** Migrating existing pie menus from Wheelnav.js to D3.js for improved usability, stability, aesthetics and future proofing. (May 8- June 1)
 - **Stage 2:** Enhancing synth and sampler capabilities by updating Tone.js integration, refining the sampler widget, and adding multi-sample instrument support.(June 2 - September 1)
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Impact on Sugar Labs

- **Enhanced UI with D3.js:** Transitioning to D3.js ensures smoother, more responsive, and visually appealing UI interactions, providing users with a more intuitive and enjoyable experience.
- **Advanced Audio Features:** Updating Tone.js and refining the sampler widget will significantly enhance the audio quality and flexibility within Music Blocks, allowing for precise tuning, micro-adjustments, and improved sample management.
- **Improved Sample Widget:** The redesigned Sample Widget will support larger file sizes, advanced metadata tagging, and preview functionalities, making it easier for users to manage and experiment with audio samples. The new design also makes it easier to add more features to the sampler.
- **Multi-Sample Support:** Implementing multi-sample support allows dynamic audio selection based on musical context (short/long, high/low sounds), resulting in more realistic and expressive sound production, directly benefiting educators and learners in music education.

- **Future-Proof:** Utilizing D3.js for UI enhancements ensures easier future expansions and maintenance, since it has a lot more visualisations than just pie menus, helping music Blocks as an evolving educational tool.
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Timeline & Implementation Plan

Community Bonding & Stage 1 (May 8 – June 1):

- Engage with mentors and community, discuss project specifics, get to know more about their vision of Music Blocks.
- Complete migration to D3.js for all pie menus:
 - Fully implement pie menu prototypes with D3.js across all UI elements (May 8 – May 25).
 - Perform final polishing and address maintainer feedback to ensure smooth implementation (May 26 – June 1).

Stage 2: Enhancing Synth and Sample Features (June 2 – September 1)

Week 1 (June 2 – June 9):

- Finalize environment setup for audio enhancements.
- Review current implementation in `js/widgets/sampler.js` and `js/utils/synthutils.js`.
- And identify critical upgrade points.

Week 2 (June 10 – June 16):

- Update Tone.js to the latest stable version and resolve compatibility issues that come with the update.
- Design, improve and finalize on UI mockups for the sampler widget, incorporating mentor feedback (20 hours).

Week 3 (June 17 – June 23):

- Refactor sample management to support larger file sizes, metadata tagging, and improved preview functionality.
- Start implementation of tuner (similar to this one -[Musicaa Tuner](#)) and pitch micro-adjustments within the sampler widget (20 hours).

Week 4 (June 24 – June 30):

- Integrate advanced pitch detection and microtuning features.
- Develop interactive pitch adjustment controls (e.g., sliders, visual pitch indicators).
- Conduct initial usability tests (20 hours).

Evaluation 1 (July 1): Present completed sampler widget with refined sample management and tuning functionalities.

Weeks 5–9 (July 2 – August 4):

- Port curated free/libre/open samples into Music Blocks . Some sources I had in mind -
 - Freesound.org
 - The Internet Archive (Audio Section)
 - University of Iowa Musical Instrument Samples
 - BBC Sound Effects Archive
 - OpenGameArt.org
- Enhance user-facing sample menus, organize instruments visually with intuitive icons.
- Create interactive UI demonstrations showcasing the improvements (25 hours/week).

Weeks 10–12 (August 5 – August 25):

- Implement multi-sample support, enabling dynamic audio sampling based on musical context (short/long, high/low sounds).
- Thorough testing, documentation, and robustness improvements.

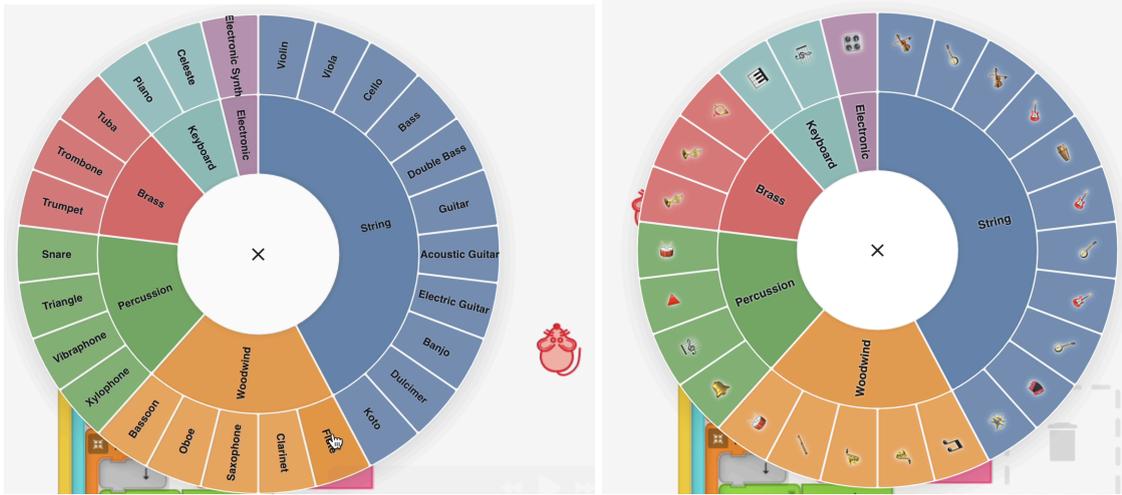
Final Evaluation & Wrap-up (August 26 – September 1):

- Comprehensive testing and debugging.
- Documentation finalization and preparation of project demonstrations.

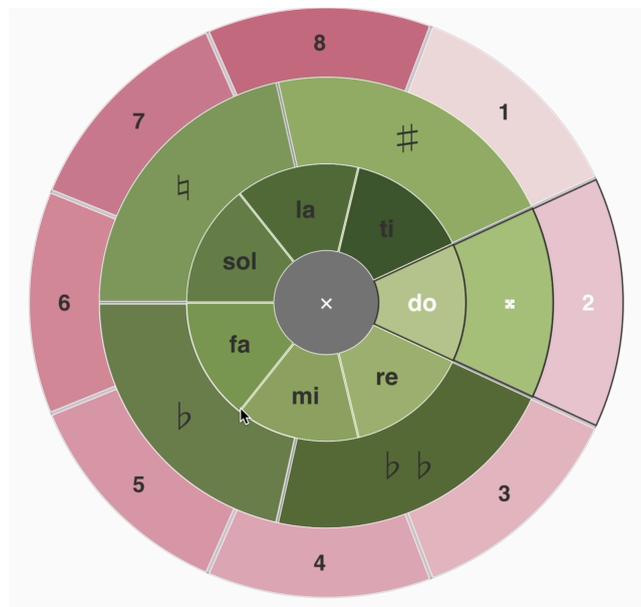
Why I am A Good Fit??

I have been actively involved in enhancing the user interface of the Set Instrument feature. My recent pull request [Refactor instrument selector to grid layout #4579](#) reflects my current efforts in migrating pie menus components from Wheelnav.js to D3.js, a transition aimed at leveraging more customizable and robust visualizations and making music blocks future proof. I am working on this right now and aim to work on this even after the GSoC application deadline and just will finish most of the work on this D3 migration before GSoC strats. Till now, I have created practical, functional designs, thoroughly testing their feasibility before proposing them, thus minimizing potential errors they might cause.

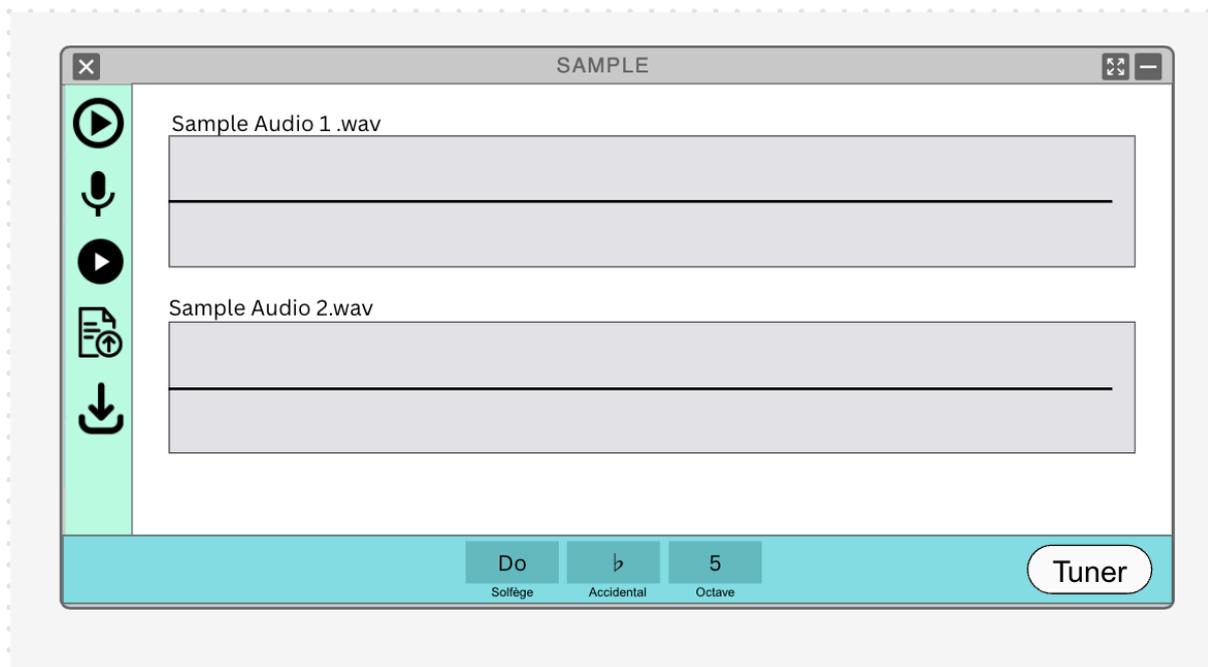
I've designed comprehensive and detailed mockups for components like the Set Instrument menu, Set Pitch menu, and the Sample Widget. Which can be seen in the following images-



Set Instruments Designs (left- with text , right- with sample placeholder icons)



New Pitch Wheel (this improves current transitions, also adds pie slice section, hover effect and a pitch based-color shading)



New Sample Widget (includes new Tuner feature and also micro adjustments in pitch)

These are just a few of the many designs I've worked on. It has been an ongoing process, and you can refer to this PR to see complete animations of these functions and other designs I have proposed. Currently, I am working on even more pie designs.

Although my current contributions may not yet show code commits, it's because I am still making improvements and sharing them with Walter Bender for reviews. Each proposed design is carefully implemented and tested, which takes considerable time and effort, even if it's not immediately visible as merged code. These designs are not just conceptual – they actively exist in my IDE, so I can push the changes at any time, making the integration process quick when needed.

The ongoing PR [Refactor instrument selector to grid layout #4579](#) currently has over 22 back-and-forth discussions, reflecting my commitment to collaborative

refinement. Additionally, I have maintained prompt and effective communication with the maintainers, showcasing strong work ethics.

Despite balancing academic commitments, I have made significant progress, and I am confident that my productivity will increase even more during the summer when I have fewer external responsibilities.

Post-GSoC Plans

I intend to continue actively contributing to Music Blocks and Sugar Labs by:

- Regularly testing, identifying, and resolving issues.
- Submitting pull requests and enhancing existing features.
- Supporting and mentoring future contributors.

Additionally, I aim to utilize Music Blocks in my own music studies, providing real-world testing and valuable insights, which will further enhance the project's relevance and educational impact.