

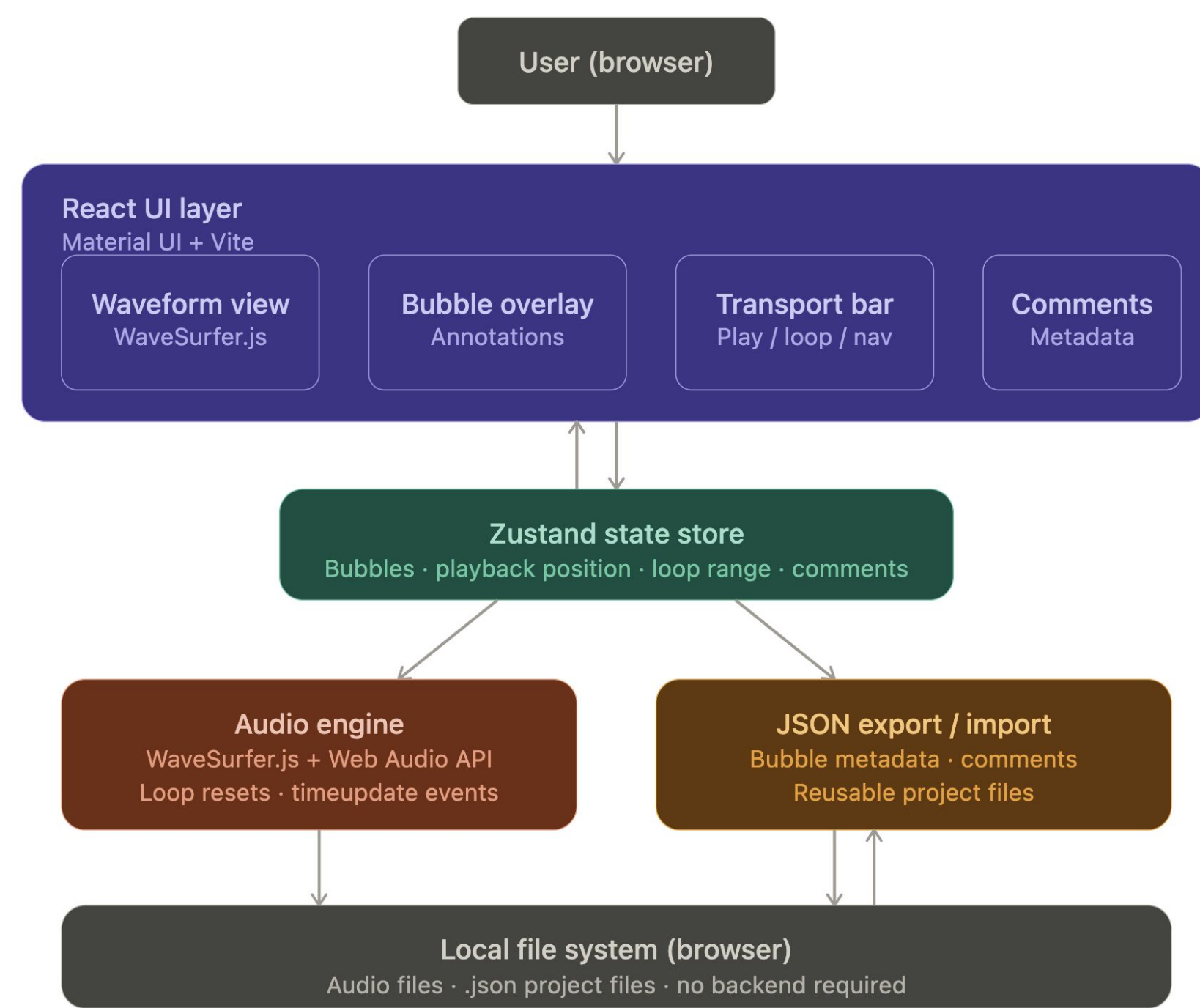
PROJECT OVERVIEW

BubbleMachine is a browser-based audio analysis tool that lets users visualize waveforms, create time-based "bubble" annotations, attach comments, and control playback with millisecond precision. Built with React, WaveSurfer.js, and the Web Audio API, the system runs entirely in the browser using local audio files — no backend required. Project data is saved as portable JSON files for easy export and reuse across sessions.

MOTIVATION

Music analysis in classroom settings has traditionally meant playing audio from start to finish, making it hard to isolate and revisit specific moments. BubbleMachine solves this by letting users mark time-based regions directly on a waveform, attach comments, and loop precise sections with millisecond accuracy — all within the browser, no backend required. The result is a more visual, repeatable, and accessible approach to audio analysis on both desktop and tablet devices.

SYSTEM-LEVEL DIAGRAM



TESTING & VERIFICATION

BubbleMachine was validated through targeted tests covering each major system component. Waveform rendering, audio playback, bubble creation, and comment handling were verified independently before full-system integration. Loop playback was tested for both single bubbles and multi-bubble sequences, confirming accurate range computation and reliable resets. Keyboard shortcuts, touch interaction, and bubble traversal were validated across desktop Chrome, Safari, and iPad simulation. Repeated file load and remove cycles confirmed stable memory behavior. Integration followed a subsystem-first approach — each component verified in isolation before paired and full-system testing — reducing risk and isolating issues earlier in development.

TEAM MEMBERS



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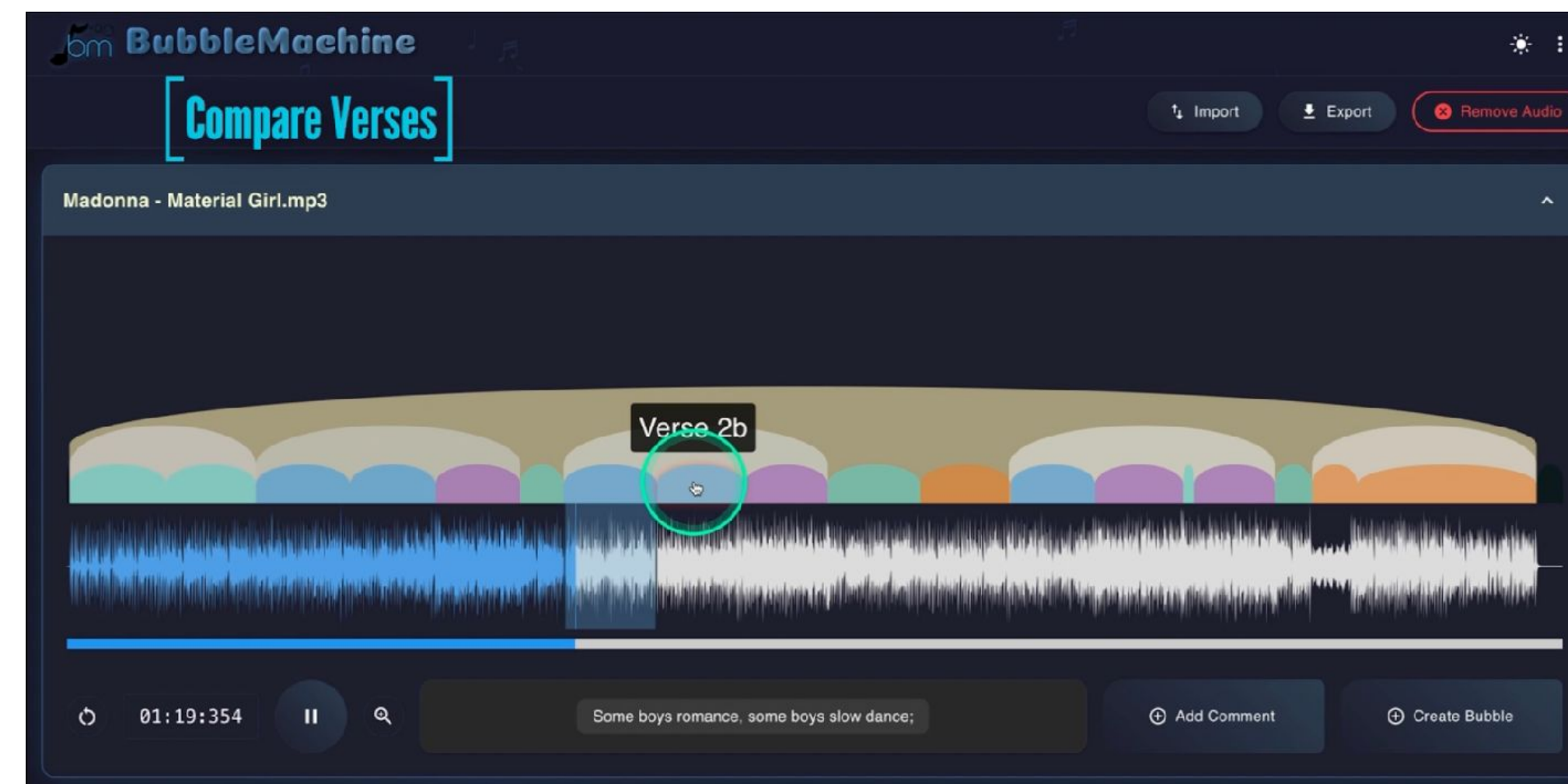


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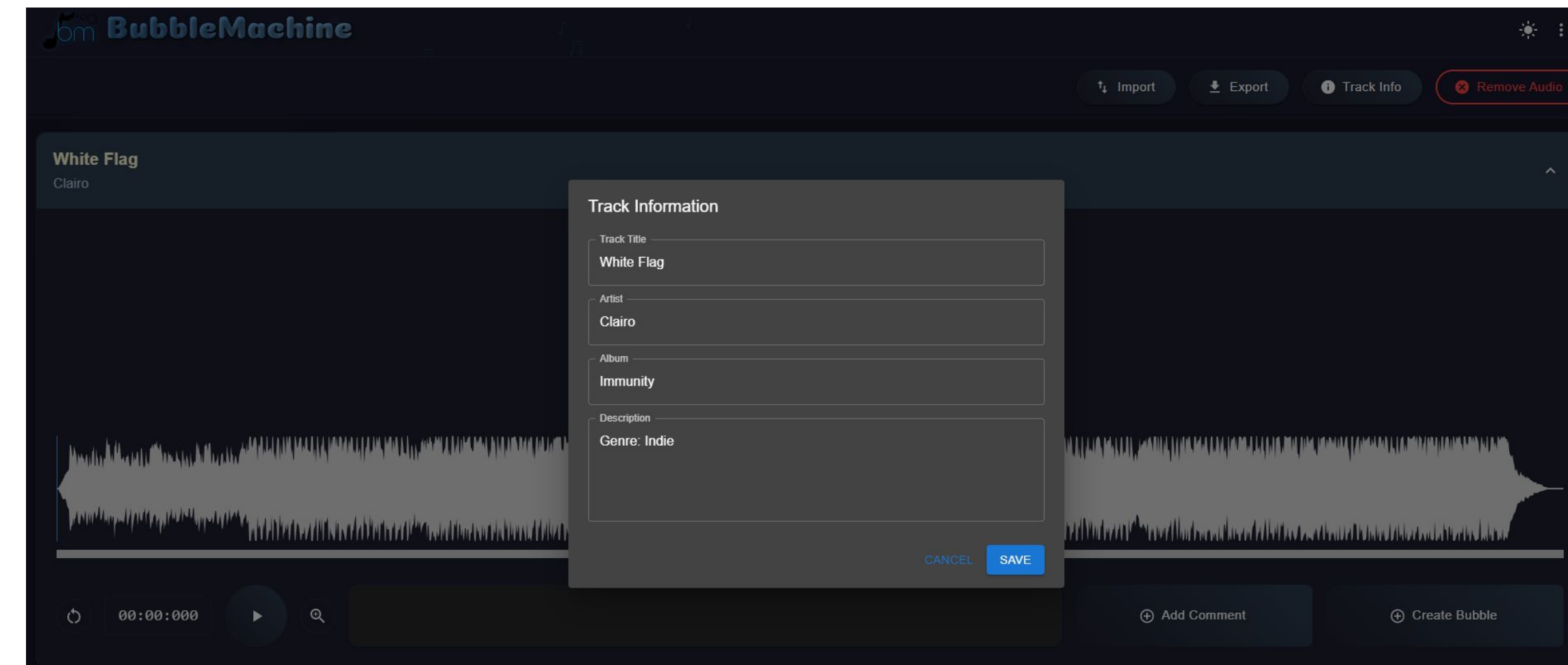
INTERFACE & DESIGN ILLUSTRATION



The interface combines the waveform, colored bubble overlays, comments, and transport controls so users can inspect and compare musical structure directly against the audio timeline.

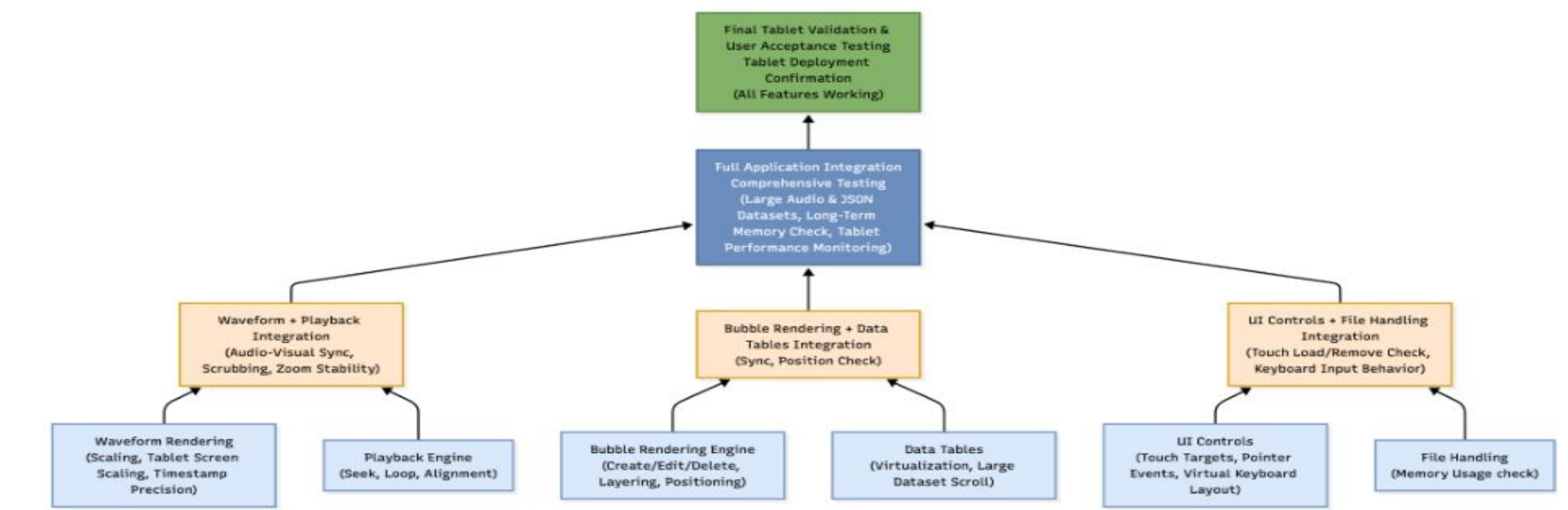
NEW FEATURES ADDED

- Loop playback for a single selected bubble
- Loop playback for user-defined sequences of consecutive bubbles
- Keyboard shortcuts for play/pause, looping, next/previous bubble traversal, and quick playback around a selected bubble
 - Shift-click multi-bubble loop selection with visual feedback
 - Loop status chip showing active time range and bubble count
- Tablet support for .mp3, .mp4, .wav, and .aiff files with touch-based audio scrubbing
 - Metadata screen supported by extended JSON file



The metadata screen pops up when user loads an audio file, and can store the track's title, artist, album, and a description. It can be accessed and edited again by clicking the Track Info button.

INTEGRATION / WORKFLOW



RESULTS & IMPACT

BubbleMachine achieved stable waveform rendering with accurate bubble synchronization across all tested audio files. Loop playback proved reliable for both single and sequential bubbles, with computed ranges and resets performing consistently. Usability improvements — including larger touch targets and tablet-friendly controls — made the tool accessible across desktop and tablet devices. Keyboard shortcuts and quick navigation reduced friction during extended review sessions. Structured JSON export and import enabled reusable instructional datasets, allowing annotations to be saved, shared, and reloaded across sessions without data loss.

CONCLUSION

BubbleMachine successfully delivers a browser-based platform for structured audio analysis, combining waveform visualization, bubble annotations, comments, and advanced playback controls into a single cohesive tool. Running entirely in the browser with no backend dependency, it supports both classroom instruction and independent audio review across desktop and tablet devices. The addition of loop playback, keyboard shortcuts, and JSON-based project data makes audio analysis more precise, repeatable, and accessible than traditional linear playback approaches. Future work could explore cloud-based project sync, collaborative annotation, and support for additional audio formats.

ACKNOWLEDGEMENT

Sponsor: BubbleMachine, Founder: Dr. Scott Lipscomb
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REFERENCES

Integration Readiness Report
System Integration Test Report
Project Source Code (GitHub repository)
Test screenshots