AI AND THE SITAR: PRESERVING AND TRANSFORMING A LIVING TRADITION

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Abstract
The sitar is not only a classical instrument but also a living tradition that continues to evolve through performance, teaching, and audience interaction. With the rise of Artificial Intelligence (AI), this tradition is experiencing new forms of change. On one hand, AI tools such as machine learning and audio analysis are being used to document and study ragas, improvisations, and stylistic differences across gharanas. This helps preserve valuable knowledge and makes classical music more accessible to younger audiences worldwide. AI also allows us to see how sitar performances circulate on digital platforms, shaping how the tradition is received and remembered. On the other hand, the use of AI to create sitar-like compositions raises important concerns about authenticity, creativity, and the risk of reducing a deeply spiritual and human practice into patterns generated by algorithms. This paper explores how AI is influencing the sitar both as cultural heritage and as a living, evolving art form. It argues that while AI can enrich the documentation and reach of this tradition, its use must remain sensitive to the artistic and cultural values that keep the sitar alive as more than just sound—it is an ongoing practice of meaning, memory, and identity.
Keywords: *Artificial Intelligence, Sitar, Classical Music, Living Tradition.*

1. Introduction

The sitar, an emblematic voice of Hindustani classical music, carries centuries of tradition rooted in oral transmission and personalized mentorship. Its performance embodies microtonal nuances—22 shrutis, fluid improvisation, and emotional depth. Artificial intelligence introduces new paradigms: tools for preserving authenticity, new creative agents, and platforms for broader access. This paper explores AI's twin capacities: preservation of traditions and transformation of practice.

2. Background & Related Work

2.1 Preservation through AI: Microtonal Modelling

Shruti Sense is a symbolically grounded system designed to correct pitch inaccuracies and complete melodic sequences while respecting the 22-shruti framework and raga grammar. It combines a shruti-aware finite-state transducer (FST) and a grammar-constrained Shruti Hidden Markov Model (GC-SHMM), achieving 91.3% shruti classification accuracy—even under ±50 cent pitch noise—across multiple ragas. This model exemplifies precision in preserving microtonal integrity.

2.2 Raga Identification and Explainability

A CNN-LSTM model trained on 191 hours of Hindustani Classical Music (HCM) recordings, annotated for ragas, achieved an F1-measure of 0.89 in raga identification. The study applied explainability tools—Sound LIME and Grad CAM++—to assess whether the model's focus aligns with human expert reasoning, finding significant alignment. This verifies not only accuracy but interpretability.

2.3 Generative Models: Raga Creation

The Raga Multi-Track Music Model (RMMM) uses LSTM and Transformer architectures to generate multi-layered raga music across instruments, promoting emotional and structural fidelity. More broadly, hierarchical generative models like Ga Ma Dha Ni propose pitch-contour-based intermediaries to synthesize expressive vocal melodies, supporting controlled AI-human collaboration such as "primed generation" and "pitch conditioning".

2.4 Stem Separation for Indian Classical Music

Sur, developed by Shanti Ghose, is an AI-powered tool crafted specifically for Indian classical music stem isolation. Trained on 350 manually separated tracks, it effectively isolates instruments like sitar and tabla—tasks where Western-centric tools fail. Its launch in early 2024 introduced a freemium and subscription model, along with a curated sample library and fair revenue-sharing for contributing artists.

2.5 Generative Performance: Live Jugalbandi

At MIT Media Lab in June 2025, "Jugalbandi Reimagined" showcased a live duet between a sitarist (Mansoor Rahimat Khan) and generative AI (Manaswi Mishra), exploring improvisation and cultural vocabulary in real time. This performance bridged tradition and technological innovation in dynamic practice.

2.6 Ethical Considerations

Early work by Shukla & Chakraborty (2012) argued that modelling raga structure is more ethical than mimicking specific artist performances, preserving emotional authenticity and respecting tradition. Concerns about AI diluting the guru–

shishya dynamic and cultural depth echo these ethical tensions.

3. Methodology

3.1 Data Collection

Audio corpora: High-quality sitar recordings across ragas, performance contexts, and gharanas.
Annotations: Detailed raga labels, shruti/transcription data, improvisation structure.
Stem libraries: Manually separated sitar tracks to train stem isolation models.
Performance recordings: Live improvisations, performance video/audios for interactive modelling.

3.2 Model Development

Preservation Models: Extend Shruti Sense across more ragas, integrate gesture or sensor data.
Identification & Explainability: Expand datasets and architectures; integrate interpretability tools (e.g., Sound LIME).
Generative Models: Improve RMMM and Ga Ma Dha Ni frameworks to include sitar-specific modules and hierarchical conditioning.
Stem Tools: Enhance Sur's multilingual datasets and ensure integration with DAWs.

3.3 Evaluation Framework

Quantitative: Accuracy metrics for pitch correction, raga classification, reconstruction fidelity.
Qualitative: Expert evaluation by sitarists and teachers of model-generated melodies, pitch corrections, and stems.
Ethnographic Study: Interviews with gurus, students, and performers about tool adoption, cultural sentiments, and pedagogical impact.
Performance Outcomes: Track use in live settings (e.g., AI-assist, duet performances).

3.4 Ethical & Cultural Safeguards

Non-replacement Principle: AI tools designed as aids—augmenting the guru–shishya relationship, not replacing it.
Consent and Ownership: Recording and usage rights clearly defined; fair artist revenue from sample use.
Cultural Sensitivity: Tools developed with musicians, ensuring they respect stylistic and spiritual elements.
Inclusivity: Expand datasets to include underrepresented gharanas, ragas, and regional styles.

4. Results & Discussion

4.1 Preservation Impact

Shruti Sense demonstrates technical capability to maintain microtonal authenticity—a significant step in preserving sitar expression. Raga identification tools help in cataloguing, archiving, and indexing vast performance collections.

4.2 Creative Transformation

Generative models (RMMM, Ga Ma Dha Ni) serve as creative partners, suggesting patterns and improvisational motifs while allowing musicians to retain control. The MIT live performance exemplifies synergy between tradition and AI, situating machines within cultural frameworks.

4.3 Accessibility & Production

Sur democratizes access to traditional elements, enabling producers to sample classical layers and integrate them into new compositions. Its revenue-sharing model and curated archive support both cultural reach and artist empowerment.

4.4 Ethical Balance

Adopting the principles from neuro-symbolic ethics—focusing on structure over replication of artist style—ensures AI aligns with tradition. Artist involvement, transparency, and contextual use guard against misappropriation.

5. Conclusion & Recommendations

AI holds transformative promise for both preserving the sitar tradition and energizing its future. Properly designed, these tools become allies in documentation, pedagogy, and creativity without replacing human mentorship.

Recommendations:
Co-create AI tools with practitioners to anchor them in authentic practice.
Build publicly accessible, ethically sourced datasets with diverse representation.
Integrate AI tools into teaching platforms, archives, and DAWs with built-in feedback loops.
Foster interdisciplinary collaboration among musicologists, technologists, and cultural stakeholders.

6. Future Work

Interactive AI companions: Real-time feedback systems for learners with pitch, rhythm, and stylistic guidance.
Embodied Interfaces: Gesture- or sensor-enabled sitar augmentations responding to performance.
Cross-modal generative tools: Linking melodic generation to visuals, lyric context, or emotional frameworks.
Expanded ethical frameworks: Incorporating Indigenous frameworks, power dynamics, and postcolonial perspectives.

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