

Decentralized Music Distribution: Enhancing Independent Musicians' Reach Through Blockchain and AI

A Technical Report Submitted to the Department of Computer Science

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, VA

In Partial Fulfillment of the Requirements for the Degree

Bachelors of Science, School of Engineering

Muhammad Al-Atrash

Fall 2024

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Rosanne Vrugtman, Department of Computer Science

Decentralized Music Distribution: Enhancing Independent Musicians' Reach Through Blockchain and AI

CS4991 Capstone Report, 2024

Muhammad Al-Atrash
Computer Science
The University of Virginia
School of Engineering and Applied Science
Charlottesville, Virginia USA
hn2bat@virginia.edu

ABSTRACT

The current music distribution landscape is skewed towards mainstream artists, leaving independent musicians at a disadvantage. I propose a decentralized music distribution platform that leverages blockchain technology for fair revenue distribution and AI-driven music discovery systems to support and promote independent musicians. The platform's community-driven approach would democratize music discovery, ensuring lesser known artists have a fair chance to reach wider audiences. By addressing the limitations of existing platforms, this project would create a more artist-centric and inclusive music ecosystem. Future work will focus on enhancing the AI recommendation engine and testing the platform with diverse user groups to ensure scalability and effectiveness.

1. INTRODUCTION

The current music distribution landscape presents significant challenges for independent musicians, who often find themselves at a disadvantage compared to mainstream artists. Platforms like Spotify and Apple Music, which were initially designed to democratize music discovery and distribution, now prioritize well-established musicians. Algorithmic biases favor mainstream content, and existing monetization structures

disproportionately benefit major artists, leaving independent musicians with limited exposure and inadequate revenue generation.

These issues create a barrier to musical innovation and diversity, as lesser-known artists struggle to gain recognition in an industry dominated by a few.

To address these challenges, a new approach is needed that emphasizes fairness in revenue distribution and improved exposure for independent musicians. The decentralized music distribution platform proposed in this report seeks to create a more equitable environment for these artists. By leveraging blockchain technology, the platform ensures transparent and fair revenue distribution through smart contracts. In addition, the platform integrates AI-driven music discovery systems that cater to niche musical subgenres, offering independent musicians a better chance to reach wider audiences.

2. RELATED WORKS

The challenges faced by independent musicians on major music streaming platforms have been explored in various studies, with many highlighting the limitations of centralized systems and algorithmic biases. For example, Forbes (2021) emphasizes how current streaming platforms, such as Spotify, disproportionately benefit mainstream artists through their monetization models, leaving

independent musicians with limited visibility promote independent artists and democratize and inadequate revenue opportunities. This the music industry. centralization of power among a few major players in the music industry has stifled innovation and cultural representation. The need for more equitable systems that promote independent artists has been widely acknowledged.

One potential solution is the integration of blockchain technology into music distribution. Johansson (n.d.) discusses how blockchain can decentralize control in the music industry by enabling transparent and fair revenue distribution through the use of smart contracts. By eliminating intermediaries and automating payment processes, blockchain-based platforms can offer artists a larger share of the revenue from their work, compared to the current industry standards. This technology has been shown to hold promise in creating a more equitable music ecosystem.

In addition to blockchain, AI-driven music discovery systems are also playing an increasing role in promoting lesser-known artists. LANDR (n.d.) provides an in-depth look at Spotify's algorithm and explains how it often favors mainstream content, reinforcing the dominance of major artists. However, recent advancements in AI-based music discovery, such as AI genre recognition and recommendation engines, offer the potential to break this bias by identifying niche subgenres and helping independent musicians gain visibility. Such AI-driven systems can empower listeners to discover a broader range of music that extends beyond the mainstream.

Together, these technologies—blockchain for transparent revenue distribution and AI for enhanced music discovery—form the foundation for this project's decentralized music distribution platform, which aims to

3. PROJECT DESIGN

This section outlines the design of the decentralized music distribution platform, detailing the integration of blockchain technology for revenue distribution and AI systems for personalized music discovery. The goal is to create a fair, scalable, and artist centric solution that empowers independent musicians and enhances the listener experience.

3.1: System Overview

The decentralized music distribution platform is modeled after Audius (a decentralized streaming platform built on the Ethereum blockchain), leveraging the Solana blockchain for its high throughput, low transaction costs, and scalability. The platform is designed to provide transparent and fair revenue distribution for independent musicians while utilizing AI-driven music discovery to highlight lesser-known subgenres. By eliminating traditional intermediaries in music distribution processes, the system ensures a more equitable space for musicians and listeners alike.

3.2: Blockchain Integration with Solana

Solana is chosen for its ability to handle thousands of transactions per second, making it ideal for a platform that may scale to millions of users and transactions. The platform uses smart contracts to manage payments and licensing agreements. Musicians upload their tracks to the platform, and every stream is logged immutably on the time-stamped Solana blockchain. The revenue generated from each stream is automatically distributed to the artist in near real-time, without the need for intermediaries, ensuring that independent musicians receive a larger share of the revenue compared to traditional

platforms. Specifically, the smart contract deployed on the Solana blockchain will: 1) log the number of streams a song receives, 2) automatically execute payments directly to artists using Solana's native token (SOL), with the potential for integration with stablecoins (e.g., USDC) to mitigate volatility, and 3) ensure transparency in payouts by providing artists with an immutable record of their earnings.

3.3: AI-Driven Music Discovery

A key differentiator of the platform is its AI powered recommendation engine, which emphasizes discovering niche subgenres rather than relying on engagement metrics like likes, shares and follows that dominate traditional platforms. The AI system will use natural language processing (NLP) and audio feature extraction to identify and classify tracks within smaller subgenres, especially those underrepresented in mainstream music platforms.

This process starts by analyzing both metadata and audio characteristics such as rhythm, tempo, tonality, and instrumentation to pinpoint the specific subgenre a song belongs to. Specifically, the platform will use machine learning models to parse user-generated tags and descriptions of songs. It will correlate these with known subgenres, refining its

understanding of the song's specific characteristics. Additionally, the AI will analyze the raw audio data of songs, focusing on features like spectral content, harmonic structure, and beats per minute (BPM), to detect unique patterns corresponding to niche subgenres.

The system is trained on a large dataset of songs across various genres and subgenres to continually improve its accuracy. By recognizing nuanced differences between closely-related subgenres (e.g., indie pop vs.

bedroom pop), the platform can offer users highly personalized recommendations that go beyond surface-level genre labels.

To counter the bias of engagement metrics/prioritization of mainstream content, the platform's AI recommendation system will deemphasize these metrics in favor of listening habits and content diversity. By doing this, the

system supports artists who may not have large followings but produce high-quality content within niche subgenres, thereby offering listeners a broader, more diverse music discovery experience.

3.4: User Interaction Flow

Musicians and listeners will interact with the platform through a decentralized interface, where musicians can upload their tracks, set licensing terms, and track revenue. Listeners will create accounts and receive personalized recommendations based on their listening preferences. The blockchain aspect will remain mostly invisible to users, maintaining a user-friendly experience while benefiting from the underlying decentralization. Listeners can tip artists directly, and musicians can engage their fan base through exclusive releases or direct messages, all facilitated through the decentralized structure of the platform.

The choice of Solana ensures scalability for handling a large number of users and transactions. However, some challenges include scalability and AI processing. As the user base grows, maintaining real-time recommendations with a large volume of data may require additional optimizations in the AI architecture, such as distributed machine learning. Additionally, storing large audio files on decentralized networks remains a challenge, though integrating with decentralized storage solutions like Arweave

or IPFS could address this.

4. ANTICIPATED RESULTS

The proposed decentralized music distribution platform is expected to significantly improve revenue transparency and equity for independent musicians. By utilizing smart contracts on the Solana blockchain, artists will have direct access to real-time revenue data for each stream, allowing for a more transparent and fair distribution of income. This approach will eliminate the need for third-party intermediaries, ensuring that artists retain a larger share of their earnings compared to traditional platforms like Spotify, where centralized control and complex payment structures often leave independent musicians with minimal compensation.

In addition, the AI-powered music recommendation system is designed to enhance the visibility of niche subgenres and lesser-known artists. By analyzing both audio features and user listening habits, the system will provide highly personalized recommendations that introduce users to a broader range of music, beyond mainstream hits. This shift away from prioritizing engagement metrics such as likes and shares is expected to help independent musicians gain more exposure and create a more diverse listening experience for users, who will be able to discover new and unique sounds within their preferred genres.

5. CONCLUSION

Overall, the platform anticipates fostering a more inclusive and artist-friendly music ecosystem. Independent musicians who traditionally struggle with visibility and revenue generation on mainstream platforms will have a more equitable opportunity to reach wider audiences and generate meaningful income from their work. By

democratizing both revenue distribution and music discovery, this platform aims to support innovation and creativity in the music industry while benefiting artists and listeners alike.

6. FUTURE WORK

Future work will focus on further enhancing the AI-driven music discovery engine to improve its accuracy and ability to recommend niche subgenres effectively. This includes expanding the training dataset to cover a broader range of musical styles and implementing distributed machine learning techniques to handle the increased data volume as the platform scales. Additionally, the integration of decentralized storage solutions, such as Arweave or IPFS, will be explored to efficiently store and manage large audio files while maintaining the platform's decentralized nature.

Another key area of development will involve extensive user testing to gather feedback on both the functionality and user experience of the platform. This will help identify and address any usability issues and ensure that the blockchain elements remain intuitive and unobtrusive for users. Future iterations of the platform may also explore incorporating stablecoin payment options to minimize revenue volatility for artists and potential partnerships with independent artist collectives to foster a strong, engaged community.

REFERENCES

Forbes Business Council. (2021, July 7). How can streaming platforms better support independent musicians? Forbes. Retrieved from <https://www.forbes.com/sites/forbesbusinesscouncil/2021/07/07/how-can-streaming-platforms-better-support-independent-musicians/>

Johansson, N. (n.d.). From Spotify to blockchain. LinkedIn. Retrieved from <https://www.linkedin.com/pulse/evolution-music-industry-from-spotify-blockchain-nova-johansson/>

LANDR. (n.d.). Spotify's algorithm explained. LANDR Blog. Retrieved from <https://blog.landr.com/spotify-algorithm/>

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. <https://bitcoin.org/bitcoin.pdf>

Solana Labs. (2017). Solana whitepaper. <https://github.com/solana-labs/whitepaper/blob/master/solana-whitepaper-en.pdf>