Blockchain Based Model for Royalty Payments of Artists and Remix-Makers

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ABSTRACT

Blockchain being an arising technology in recent years; it has yet to delve more into the music industry. This paper precisely enlightens the scope of blockchain technology in the music sector. The existing music industry deals with the issue of immense plagiarism. It discredits the original artist and the disorder in recognizing the true talent of hardworking artists, which often gets overlooked by those who have fame and popularity and big music labels as a pillar to support. The purpose is to create a foundation for those who have talent but not the opportunity to shine along with the fact that every hardworking artist, irrespective of the fame or popularity, can get their deserved recognition and royalty with the prospect to be appreciated through the methodology where on an upload; With the help of Ethereum blockchain and IPFS, revenue will go directly to the artists transparently and securely. The hash and its fingerprint are generated to check for copyright. If successful, a transaction system is carried out with the help of a decentralized application.

Keywords: Blockchain, Music, royalty payments, music industry, Ethereum, FFT, hash, wallet, audio fingerprint, IPFS

1. INTRODUCTION

Blockchain as an emerging technology can be described as a hierarchical data structure that can hold records for transactions and guarantee security, transparency and decentralization. On another note, Blockchain can be thought of as a chain or record stored in immutable blocks, and the authorization is not central.

Through digitalization with revolutionary technology, peer-to-peer(P2P) transfer of equities or digital assets without any intermediate parties which is estimated to be as powerful as any of the revolutions to date. Blockchain is dignified to metamorphose every industry by redefining the managerial function and deploying various workflows and encouraging sharing new ideas. Blockchain is said to be highly secured. This is because it uses digital signature that provides deceit-free or fraud less transactions preventing any user from altering or illegally accessing another user's data without appropriate credentials and a specific digital signature.

Orthodoxly, in a centralized system, all the branches are firmly bonded to the main central system where monopolization occurs. A specific need for regular approval from the higher authorities for simple functions arises. Blockchain is decentralized when approval is eliminated resulting in a much secured, smoother, and faster transaction. Also, where a centralized system requires an immense workforce to maintain the order in the system, Blockchain is programmable. It can execute systematic functions or events where transactions can be triggered if certain conditions are met. Blockchain technology in itself consists of the following leading technologies:

Cryptographic Keys

Cryptography is a process of securing data, information, and communication by encoding and decoding through the use of some code to ensure that the right person will receive the data sent by the sender. In cryptography, a key is a string of characters used within an encryption algorithm for altering data so that it appears random. Like a physical key, it locks (encrypts) data so that only someone with the correct key can unlock (decrypt) it. [6]

Cryptographic keys entail two keys- private key and public key. These keys assist in carrying out successful transactions in a peer-to-peer system. At the end of the transaction, every individual has these two keys, which help to generate a secured digital signature that can be used as an identity reference which is the most prominent aspect of blockchain technology. Suppose

an individual wants to authorize a particular deal. In that case, it needs to be certified by a mathematical verification, after which a secured transaction can take place between two network-connected parties.

Hash Encryptions

Blockchain technology uses a hash encryption algorithm to secure the data banking on the SHA256. The details transmitted via the SHA256 algorithm are the sender's address, which is the public key, the receiver's address, the details of the transaction, and the details about his/her private key. The encrypted information is then broadcasted across the world and, after verification, is added to the blockchain. It is nearly impossible to hack the hash encryption made by the SHA256 algorithm giving the required authentication and security to the sender and receiver.

The hash's correct value can be obtained when a predetermined condition is met using some computational algorithm. A transaction is said to be complete when this particular condition comes true. Here, the blockchain miners attempt to successfully solve a mathematical puzzle that is generally referred to as the Proof of Work problem. The one who solves the puzzle first gets a reward.

Blockchain technology is prominently used in the banking and process manufacturing industry where blockchain has a system which is tightly secured that provides permanent records of thousands and millions of transactions which take place in the said industry. As in the banking industry blockchain technology has a great potential to solve various issues related to security and could significantly lower the risk of data discrepancies by providing secure records plus money could be transferred in a decentralized manner and that too at a faster pace also being comparatively cheaper.

In politics, past records have observed various accusations on the result of elections being rigged along with the tedious work of counting and recounting votes to give the final result. Using blockchain one can ensure the identity of voter through voter registration and only the legitimate votes would be counted providing reliable election platform. In recent times companies like Walmart and Etihad Airways have already partnered with blockchain firms to add transparency to the decentralized systems cutting out the intermediaries, thereby reducing costs and increasing efficiency in their respective sectors. Whereas well-known brands under Unilever such as Ben & Jerry's, Dove, Vaseline, Knorr, etc. have announced that they will be leveraging blockchain to tackle deforestation.

The proposed paper involves developing a DApp (decentralised application) using React Framework. A private local blockchain- Ganache is used to deploy the smart contracts necessary to solve the stated problem. With the help of Truffle Framework and libraries of Web3.js , the DApp is connected to the blockchain with smart contracts deployed.

The rest of the paper is structured in the following way. Section 2 conveys the background on whose basis the idea of writing the paper emerged, enlightening the existing music industry and the scope of blockchain in music industry. Section 3 basically states the review of literature. In Section 4, a brief working methodology is explained with the system architecture block diagram to explain it illustratively. The implementation and results obtained till this instance unveiled in Section 5. The conclusion and future work presented in Section 6 of the paper.

2. BACKGROUND

2.1 Existing Music Industry

The music industry peaked in 1999, owing to sales of CDs and DVDs. The music industry had been on a downward spiral due to the issue of online piracy. The command and impact of the pre-Internet music sector era were majorly based on controlling physical distribution. The physical music distribution has become extraneous due to the rise of the digital revolution. The major music companies had to restructure themselves to survive the cut-throat competition. The current music industry has been divided into three major sections:-
1) The recorded music industry—focused on recording and distribution of music to consumers.
2) The music licensing industry—primarily licensing compositions and arrangements to businesses.
3) Live music—focused on producing and promoting live entertainment, such as concerts, tours, etc.
Although the number of people acquiring and streaming music has increased exponentially, the artists' royalty payments have not improved accordingly. The Major drawbacks in the existing system includes:

1) Lack of authentic copyright database

Two types of copyrights involved in recorded music are copyright on the composition and the copyright on the recording.

a. Copyrights on Musical Composition

The rights on musical composition include the right to copy(right to reproduce), the right to distribute, and the right to perform(recording and a live audience). The music industry has amalgamated the right to copy and the right to distribute as Mechanical Rights. Hence, the primary rights that the major music publishers can license to the digital music services are Performing Rights and Mechanical Rights. Different types of collecting societies administer these rights on behalf of publishers for efficiency or collective bargaining power. Performing rights organization (PROs) handle performance royalties. Mechanical rights organization (MROs) handle mechanical rights [8].

b. Copyrights on Sound Recording

The recording artists also have the right to copy, distribute, and perform rights, but the royalty schemes and lecture schemes for them are different from those of the composers. The additional rights licensed for digital sound recordings include paid permanent download, conditional download, paid subscription stream, or ad-supported stream. After the artist records a composition, a record label owns the copyrights to the sound recordings. Along with these, the label also manages the licensing of the remixes and the use of recordings and the video, reproduction and distribution of the sound recordings. The logistics of distributing them to digital music service providers and manufacturing physical products such as CDs and DVDs. The record labels are paid royalties for the reproduction, and distribution of sound recordings by the Digital Music service Providers.

2) Delayed and unfair payments

The distribution of royalties may generally take up to several years for right holders to receive their income. The main intention for such delay is the involvement of several mediators, in which each entity has its policy, differently-structured database, and accounting system. The root of many problems with rights and royalty management in the music industry is because there is no single command for mapping recordings to their underlying compositions. The digital music compositions of independent artists are often used for remixes, advertisements, mashups, etc., without giving them credit for their work; hence it becomes tedious to look up the ownership or rights information. Subsequently, the money has to be distributed among many mediators and negotiators before reaching the artist and creators of the composition, resulting in them receiving a poor payment level. Moreover, the major label exploits the independent artists since they do not have the equality of bargaining power in negotiating licensing terms and conditions.

3) Lack of Data Transparency

Today, the music industry's greatest threat is imposed by the lack of data transparency and piracy, and illegal streaming [8]. Artists scarcely receive the vital information as they rely on labels for their stats. This is because the labels are too busy managing their data due to various negotiators and mediators with different payment systems and reporting systems. Furthermore, the intermediates' operations are not supported by any standard technology to process this vast amount of data. Therefore, to assemble, manage, and generate data daily, weekly, or monthly is beyond the music labels' extent. Lack of accessibility to data can cause a lot of damage to the artists as they are unaware of what, why, and how they are getting paid for their creations. Additionally, for conducting a successful tour or concert, the artists must know the acceptance of a particular song and its related statistics; this is not possible without transparency in data.

2.2 Blockchain in Music

The technological trend has given rise to a colossal expansion in the ways that individuals experience music which includes a lot of different types of digital music services. It has been observed that licensing music and compensating right holders such as record labels, actual recording artists , composers, music publishers is no longer feasible with the use of paper derived processes in the music industry. The royalty management process and procuring true rights has been a struggle where it needs to keep pace with evolution in music access model. It can be used to track the history of those particular rights, as users experiencing will have a transparent record of the same.

Music is a vastly extensive industry consisting of not alone artists but composers, recording labels, retailers, artist managers, and staff, an opportunity to earn stacks of money. In 2019, the total revenue of the recorded music industry amounted to 21.5 billion U.S. dollars. Streaming made up 56 percent of this figure, bringing in 11.9 billion dollars globally. In such cases holding accountability, all the inflow is quite difficult; another factor contributing to a sudden downfall is music piracy. [7]

If the music industry tries to get hold of these issues, it can be economically more substantial and stable, giving the artist their fair pay. The industry's current scenario consists of complicated laws on ownership – from ownership of the audio itself to specific lyrics within a song. There are types of copyright, namely

-- Music Work copyright -An individual who writes the song is considered the sole owner of the music copyright. One has all the rights to generate revenue from royalty performances.

-- Song copyright-Sound copyright comes into the picture when the musical composition is recorded. Under this copyright, one has the right to generate revenue by record sales (both digital and physical) and master use license fees. If one tends to sign a record, the record label gains certain rights to the Sound Recording Copyright.

The introduction of blockchain might have a revolutionary impact from piracy to royalty; every aspect can be ideally monitored using a distributed ledger. A distributed ledger is an open-source ledger that holds all records of all transactions within a blockchain. However, not necessarily; all blockchains allow all viewers to view or disclose any information; one does have the option of using permissioned blockchain. With blockchain's help, an artist can receive impartial royalty payments; venues can rein counterfeit tickets and instantly pay all artists who contributed to songs or albums; in short, it eliminates the third party. Blockchain also facilitates the practice of funding a project or venture by raising money from a large number of people for up-and-coming artists and rewards listeners for creating personalized playlists and setting up smart contracts in such a way where an artist can get paid by the likes downloads and the use in another artist remix quickly rather than waiting for years to get fair pay and can also get a quick acknowledgment. In a way, one can bring transparency and deeper, profound data insights. One can also have a global currency that supports all adjoining trade music and music-related purchases. Blockchain is highly secure; any one change in a block will show changes in other blocks simultaneously, so it is relatively challenging to attack any particular block.

To sum up, music industry blockchain solutions are [10]

- A digital rights database implemented on the blockchain.

- Tokenized rights management.

- Payment of royalties can be executed automatically.

- Music creators and producers can earn from users investing in their work via purchasing tokens.

- Total transparency and data protection.

- There would not be any copyright issues.

- Remix makers can also get their fair share.

Without losing any essential benefits, blockchain offers trust, transparency, and monitoring transactions and establishes certainty by independently validating transactions. This will allow a company to monitor, view, and test transactions in real-time. Currently, we are on the blockchain prototype transition. In a way, blockchain has a great initiative to restructure many existing industries and indeed have immense prospective to remodel the subsequent years in the music industry.

There are quite a lot of investments that are already made for research so that blockchain would be quite compatible with the already existing music industry. The aim is to build a uniform platform without any disruptions in the ongoing system.

3. LITERATURE REVIEW

In order to strengthen business processes and for establishing trust blockchain technology has created a buzz-seeking opportunity. It holds certain characteristics that makes it a valuable tool for industrial applications and a potential source of disruption for established industries. It can be considered as the newly discovered technology stressing the criterion of ''Internet of Things'', artificial intelligence, technostress, and the dark side of digital innovations.[4] Blockchain offers a decentralised platform that allows community users to carry out decentralised transactions and manage data without the involvement of third-party. The Bitcoin protocol is built on blockchain. Blockchain also acts as the backbone of most of the cryptocurrencies. However, as the research and development in the Blockchain technology has evolved, it's probable application to various sectors has emerged. In the recent years blockchain technology has concentrated heavily on sectors of the industry namely, IoT, Energy, Finance, Healthcare and Government.[4]

In the recent years, music industry has seen a widespread transformation. The internet has rearranged the music industry. Particularly the way music is being delivered to the listeners, although the technology has always been a two-edged sword. Since, music composition and creation are changing rapidly, there is a need to track song contribution and attribution beyond just streaming plays and downloads. Music composition has shifted from "ownership" to "access" and the roles of creators and consumers have blurred. The role of intermediators has intricated various aspects of the music industry such as revenue calculation, revenue share between creators and labels, copyrighting and licensing issues.

The mainstream artists and labels earn most of their revenues through live concerts and recordings, thereby challenging the new artists to get a breakthrough. In this era of varying technology Blockchain comes as a predictable retort for the generators of monopolistic supremacy for intermediators, specific distribution channels and royalty payments. It can help eliminate third-party distributors and their presence in the distribution of music. Over a decade, there have been many attempts to incorporate blockchain in the music industry with numerous diverse goals. Some of them include [1]:

Open Music Initiative: To define an open source protocol that will enable uniform identification of music creators and rights holders by defining interfaces for achieving interoperability.

Peer Tracks: Enable earning money from music streaming and simplify licensing of musical works.

Musicoin: Streaming platform promising fair compensation, transparent contracts and no intermediaries in order to support independent artists.

Resonate: Music streaming platform where musicians are paid directly through smart contracts.

Ujo Music: Compensating artists and all collaborators using crypto currency and smart contracts [1].

Blockchain Media: An upgrade of existing music data standards that enables to maintain history of changes to a song's ownership using blockchain ledger [16].

Recently Spotify has acquired the blockchain startup Mediachain Labs, whose team works on the developing of technologies to connect artists and other rights holders with tracks hosted on the Spotify service. The on-demand streaming platforms (Spotify and Apple Music) have allowed consumers to easily access music products. [9] However, they include a lot of problems like releasing music, streamlining the distribution model and funnelling more of the revenue towards the creators by eliminating fees, imposed by middlemen, between end-users and artists. [15]. Regardless of the fact that adoption of blockchain within music industry supply chain seems quite promising, there are certain shortcomings, originating from the limitations of the applied blockchain technology itself. These include adoption by large corporations and to reach critical mass it may also require not only support from distributors but also the involvement of top-level artists. [3] The Blockchain may be the device expected to re-examine how music is licensed, permitting the entirety of the industry partners to profit by a more transparent and effective system.

Copyright law-enactment is continuously evolving in order to mitigate the multi-territory licensing and the issue of timely payment as well as ensuring fair and increased revenues for artists and right holders thereby bridging the gap of transparency. Various initiatives have been launched throughout the world including "The Open Music Initiative(OMI) launched by the Berklee Institute for Creative Entrepreneurship, harnessing the expertise of the Massachusetts Institute of Technology Media Lab, in decentralised platforms that aims to promote innovation related to music and development of open source standards and guarantee appropriate payments to artists, creators and rights holders of music.[5]

Mycelia- a blockchain project launched by the Grammy award winning U.K. singer, songwriter and producer Imogen Heap, that focuses to restructure the music industry by incorporating blockchain.

4. METHODOLOGY

After observing the existing music industry and the drawbacks along, with how blockchain can help overcome them; this project brings out a way to overcome that barrier between the royalties for the true owner irrespective of the fame the artist has and make justice and a fair platform where everyone gets to have the fruit of their hard work.

The creator/remix-maker can fully upload his art of music and also get a royalty for it if the upload is copyright-free. The copyright is skillfully solved using of a decentralized system and audio-fingerprinting the song and comparing the hashes, providing double-check mechanism. Even after an unsuccessful upload, the user gets feedback about its failed attempt to upload a particular song in its system.

The following block diagram explains the entire working of the proposed model:
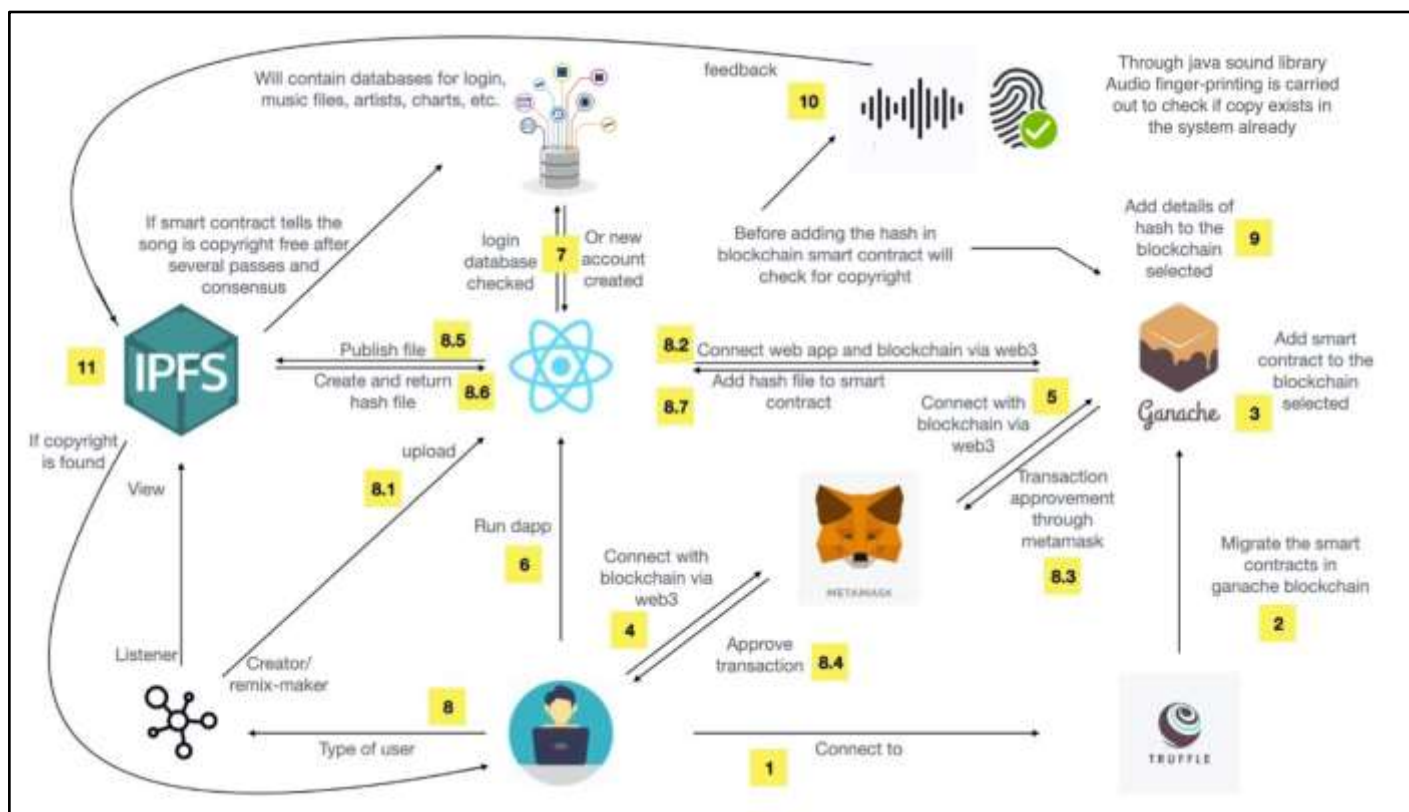
Figure.1 Overview of the Proposed System

4.1 Module 1: Hash Generation

Implementing a copyright-free platform as a developer starts with installing all the dependencies required, such as NodeJS, Truffle suite, Ganache, and metamask extension on the browser. After which the decentralized app is made with the help of React, and then the connections with IPFS(Interplanetary File System), ganache, and metamask are made and checked. If the browser where localhost is running does not have a metamask extension, it will directly show a pop-up message to install it. This is carried out various Web3.js libraries that link the local blockchain running on ganache with the react front and the smart contracts. When a song is uploaded through the portal, the song file (generally .mp3) is published on IPFS. This creates a hash of the file and is further sent through the smart contract to check for any infringement. Here, the hash is compared with other hashes present in the system. If the hash is present, it means the song already exists in the system and copyright is found. If the hash is not found, the song is further sent for audio fingerprinting.

Note that IPFS uses cryptographic hash functions to create the required hash. The raw data is sent through these cryptographically unique to the file's contents and that file only If even one bit is changed, the whole hash will be something different. The hashes are called a multi hash, where the hash itself gives information about which hash function is used or its hash's total length. Generally, it is

Observed that the first is 12 in hex which denotes the SHA-256 hash function and resultant length as 32 bytes. Then the whole thing is encoding again using the base58 encode technique. The file is actually fragmented into several parts (around 256k each), and then encoded and lastly combined into a hierarchical data structure called Merkle DAG [12] (Directed acyclic graph). A final hash is created which provides a total unique hash of the file uploaded.

4.2 Module 2: Audio Fingerprinting

After the first pass, the songs whose hash is not present in the system are sent for audio fingerprinting. Firstly, the song output is captured and converted into .wav file and stored in Byte Array. The byte array consists of the signal in its time-domain which represents the amplitude change over time. To put it another way, it is possible to represent any time domain signal by simply giving the set of frequencies, amplitudes, and phases corresponding to each sinusoid that makes up the signal. This representation of the signal is known as the frequency domain. In some ways, the frequency domain acts as a fingerprint or signature for the time-domain signal, providing a static representation of a dynamic signal.

We get the signal build of the signal through the Fast Fourier Transform (FFT) function to begin digital fingerprint formation. The frequencies are thereby analyzed based on a specific range and several intervals co-related with the tones captured

in the song. Within a particular interval, the frequency with the highest magnitude can be considered, and a signature is formed. This signature can then be part of the song as a whole. In this way, a database can be created with the signature, time of recording intervals, and song title, which includes the song name and artist name. So when a new entry is to be made, the song is identified through such databases, and the violation factor is checked. If the song is identified as one present in the database, there is a song and the song's involvement in the case of remixes. The multiple hashes ensure the total matching of the song and give an output that acts as feedback.

For instance, if the uploader does some slight changes in a particular existing file and tries to upload it ; the hash generated would differ from the existing song file and will pass the criteria mentioned in module 1. To avoid such entries audio fingerprinting helps to make the decision regarding the said entries. Here, on comparing the uploaded song with the songs present in the database, a list of songs with similar range of frequencies is observed where the outcome can be made based on the best song choice observed throughout the list. If the matching percentage witnessed is more than threshold value the song won't be permitted in the system. In case of remix, the two best choices would be taken into consideration.

If the feedback received is positive, it means the song is copyright-free and, the owner of the song is credited to it and thereby added to the song database of the application system. The uploader gets the message of the successful entry. If the new song added is a remix of different songs, all the songs identified through audio fingerprinting are considered. The artists' of that lot of songs are given some initial royalty. In this way, the artists and the remix maker acquire a perfect and monetized way to show their skills. If the feedback is negative, the song is returned to the user, showing the song identified and declaring the uploader's copyright problem. No entry is made in the system's song database.

There can be two types of users in this application- listeners and remix-maker or artists. The artists can upload their work, and listeners can listen to any of the songs of their wish. The artists also have the liberty of listening to the songs that are in the song database. Note that to correctly identify the song in the system, it is necessary to insert all the existing songs in the database before use. Since the first entry will not be recognized, the songs will get depositing in the database storage provided.

4.3 Module 3: Wallet Transaction

The royalty transfer can be accomplished with the help of another decentralized app, especially for transactions such as royalty transfer in case of remix makers and stream rate-dependent transfer, which needs to be explored and worked on more. The transaction workflow is such that it takes some principal amount from the uploaders account through the DApp. This principle amount is then distributed according to some algorithm that fairly divides the amount amongst the artists for which the remix songs are accredited.
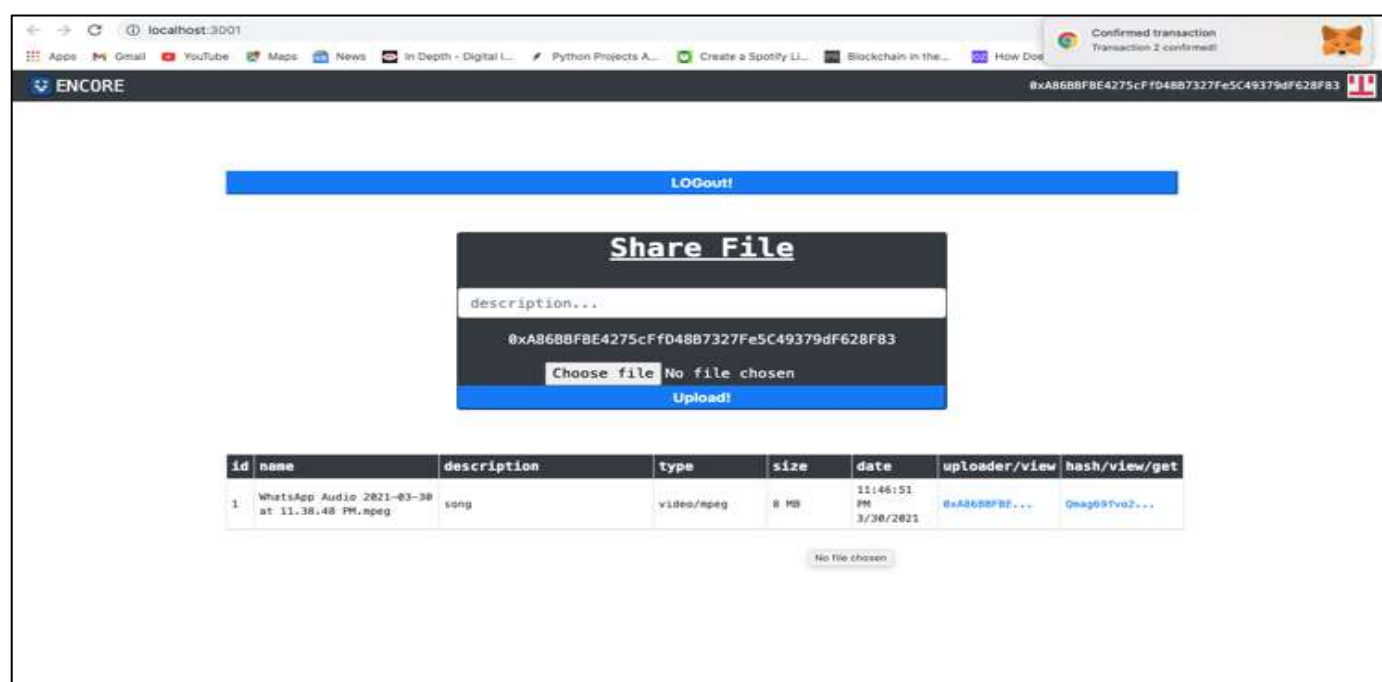
5. Implementation and Results
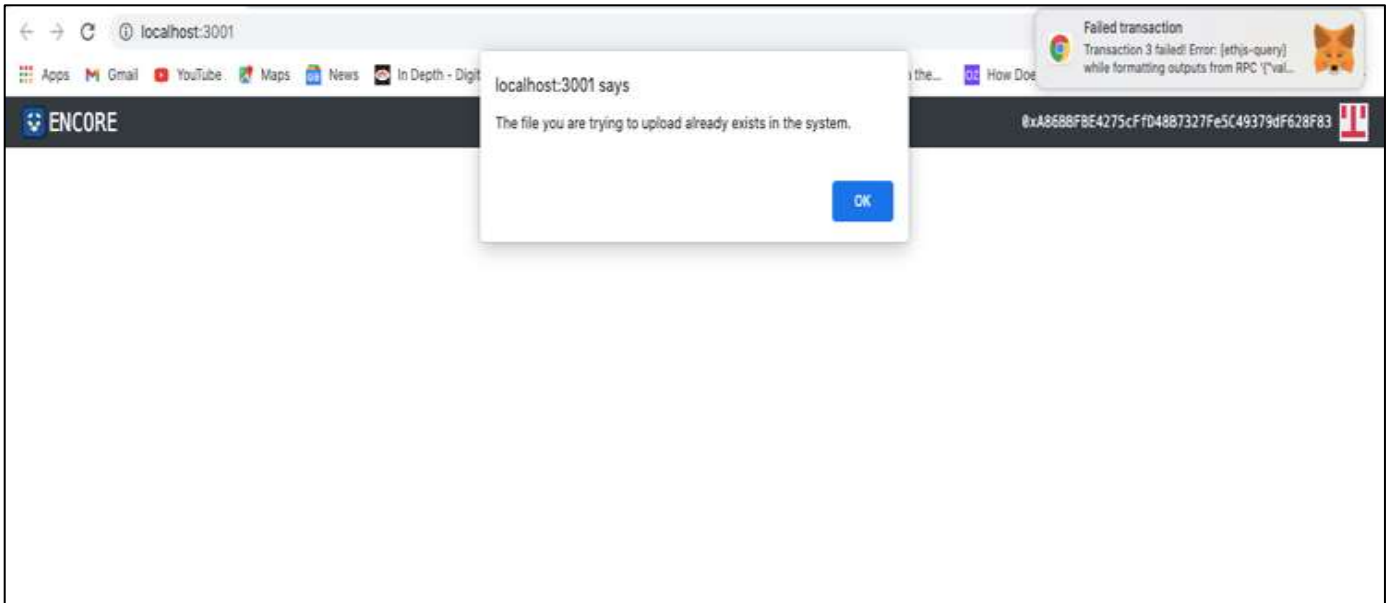

Figure.2 Uploading Song File On IPFS

Figure.3Verfication Of Duplicate Files
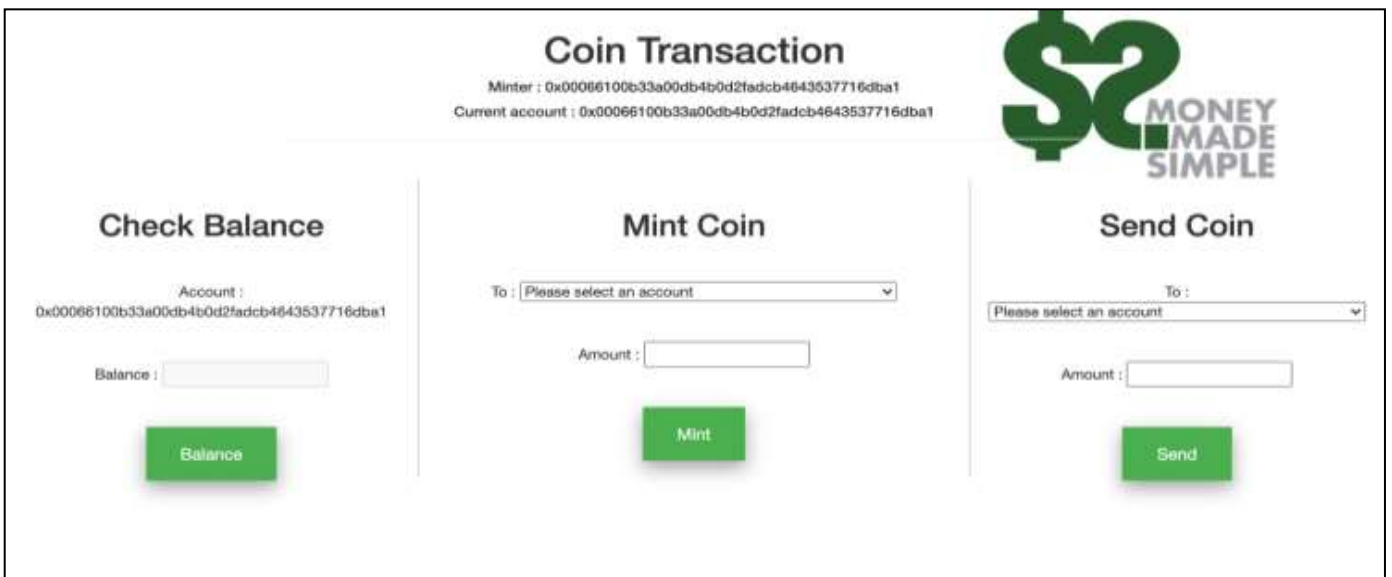
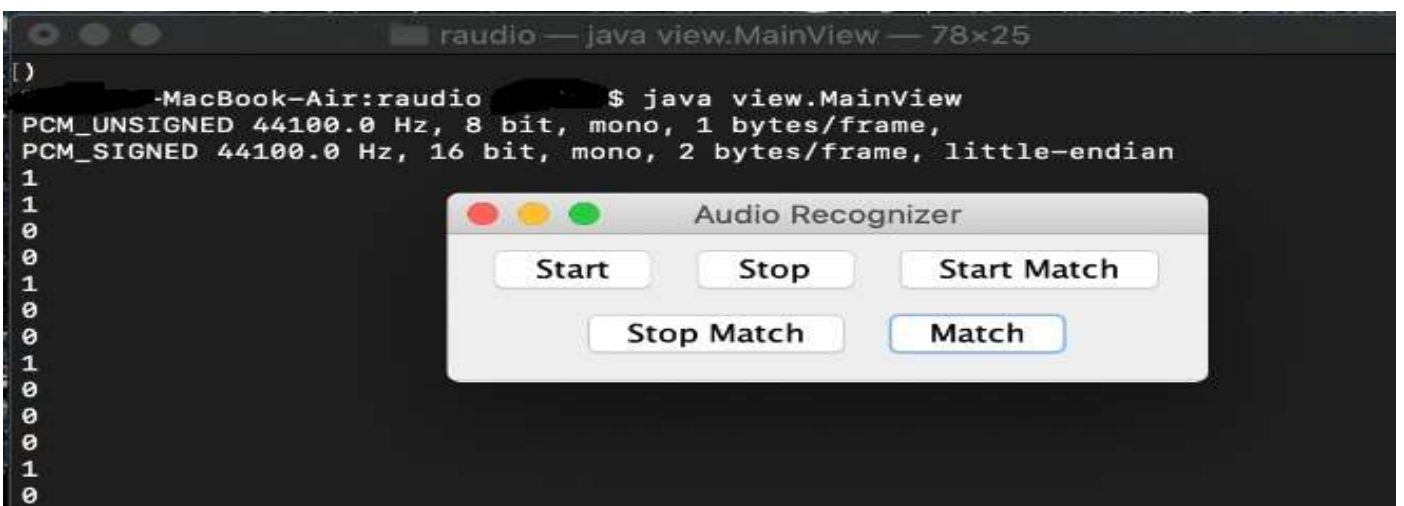*Figure.4Mining Of Coins and Transactions Between Artists and Consumer*

Figure.5 Interface to Match Songs

The Figure.2 demonstrates how a file is uploaded on IPFS. After the file is uploaded successfully a unique hash will be generated for each file, which will be displayed on the screen. The Figure.3 displays that no duplicate files can be uploaded. If the user tries to upload a file already existing in the system, then an error message will be displayed. The Figure.4 represents the mining of coins and transactions between the artists and the consumers. The start/stop and match buttons in the Figure.5 are used to match the songs with the already existing songs in the system. It will generate a list of songs in the similar range and the best song identified will be selected.

Figure.6 Logbook of Blockchain

To check the performance of the system that deployed on Ethereum and accessed through Ganache, capacity is calculated using TPS (Transaction per second).

Throughput = capacity = TPS = (block size) *(block time) (Note: considered average values)

TPS = (transactions per block) *(block per second)

So average TPS ranges between 0.35 to 1.61

Block No.	Timestamp	Gas Price	Gas Limit	Gas Used
1	2021-03-20 12:26:12	20000000000	6721975	225237
2	2021-03-20 12:26:13	20000000000	6721975	42363
3	2021-03-20 12:26:14	20000000000	6721975	1299203
4	2021-03-20 12:26:14	20000000000	6721975	27363
5	2021-03-20 14:46:54	20000000000	6721975	325608
6	2021-03-20 14:47:12	20000000000	6721975	316823
7	2021-03-20 14:47:38	20000000000	6721975	323001
8	2021-03-20 14:48:00	20000000000	6721975	329144
9	2021-03-20 14:48:16	20000000000	6721975	335359
10	2021-03-20 14:49:06	20000000000	6721975	341574
11	2021-03-20 14:49:29	20000000000	6721975	347766
12	2021-03-20 14:52:09	20000000000	6721975	31718

Table 1. Log Book Of 12 Blocks

So the observation is increasing TPS requires the decreasing block time and increasing block size.

Also Network's average latency rate also referred to as block time , which is the time required to generate the next block of transcations in the chain.So it is the amount of time a user has to wait after execution of transction .

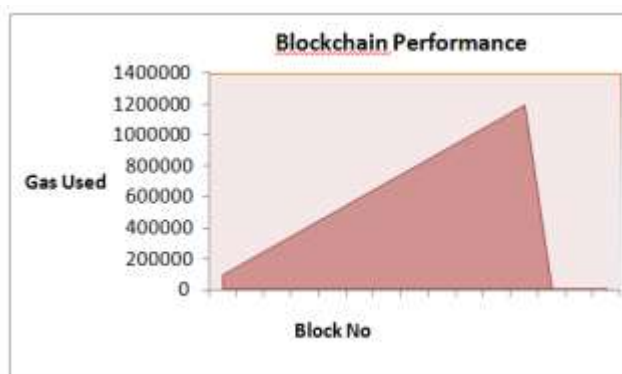So average latency for the proposed system is 0.962 to 2.8 seconds

Table 2. Blockchain Performance in Terms of Gas Usage

6. Conclusion

The music community in recent times is always in dire need to have solutions to persistent problems in regards to online consumption of original work, credit to righteous artists, and the flow in data financially. The application of blockchain in the music context has immense potential to solve such problems.

As blockchain is in a developing stage, it can be moulded to provide a distributed ledger for peer-to-peer(P2P) communications providing high security and immutable database. While on the contrary, blockchain consumes plenty of resources making it comparatively slower. The implementation and excessive management requires expertise personnel.

The paper gives a ride from all the technologies that ensure security at its best and provides the deserved royalty wherever required, and does not allow any plagiarism. It strongly takes care of the copyright issues that have become a new norm in today's age. In the future, the user can have access to their profile and play songs of his/her wish, set playlists, and get recommendations, etc., with APIs. The percentage of matching carried out in module 2 can be implemented using various ML/DL/AI algorithms. If it is an artist who wishes to produce his/her song then they have the option to publish their mark on this platform with every module integrated as a single unit.

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