WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Modern Technological Development In Music Information Retrieval

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DOI: **https://doi.org/10.55248/gengpi.2022.3.6.33**

ABSTRACT:

In present era of technology, everything is in fingertips likewise ,any unstructured data such as video ,image is captured and analyzed, but audio data such as music, sounds are very complicatedly classified and analyzed , Music information retrieval is abbreviated as ‘ MIR ‘therefore it is a interdisciplinary science of retrieval of data from music by data sourcing ,transcribing,feature extraction, machine learning algorithms, genre categorizing, pitch tracking, chord recognition and MIR applications

A simple MIR system retrieves data according to a user-introduced text query. B. "David Bowie Heroes". In such cases, the system is basically the same as a text-based search engine (Google, Yahoo, etc.) because the text is compared to the text data associated with the album or track. However, given the characteristics of the retrieved content, you need a system that can accept "musical" queries such as sheet music, sung melodies (queries by ham), and recorded audio segments (queries by example). This proposal concerns the latter case. The purpose of the sample query is to retrieve music from a large collection of digital music content based on its similarity to the sample audio document. The ability to query using examples is an important requirement of the MIR system. There are many challenges, such as computational and complexity issues, proper testbed design, and choosing the right representation of audio for queries and music collections...

Keywords: Artificial Intelligence, blockchain, Machine learning Music Information Retrieval Technology, Music Technology

I. INTRODUCTION

In the 1950s, when computers were first introduced, doctoral chemists in the United States began experimenting with computers to process music.
In the decades that followed, several large music technology research institutes were established in Europe and the United States. For example, the Music and Acoustic Computer Research Center (CCRMA), Acoustic and Music Research and Coordination Institute (IRCAM), founded at Stanford University in 1975, at Pompeu Fabra University in Paris, France in 1977 and Barcelona, Spain in 1994. UPF) Music Technology Group (MTG) and Digital Music Center (CDMQU) at Queens University in London, 2001 and more. In addition, there are many companies such as Yamaha in this field, and there are research institutes in Asian countries and regions such as Japan and Taiwan. Europe has become a global center of music technology due to its strong human and artistic atmosphere…
Music technology is an example of an interdisciplinary discipline that may be separated into two parts: art and technology. The art portion focuses on creating music utilizing various audio software and gear. The science and technology section focuses on basic computer technology research and development, as well as technological assistance for creative creativity. It's also known as Sound and Music Computing (SMC).

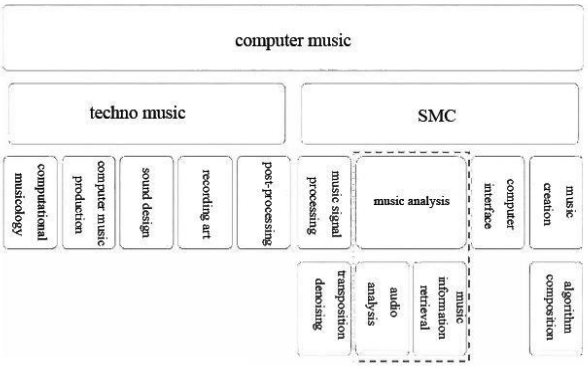

Fig.1 Relation diagrams in various fields of music technology

SMC mostly consists of Audio Signal Processing and Computer Audition (CA). MIR (Music Information Retrieval) is a component of computer listening that analyses and comprehends music material.
Massive amounts of digital music have arisen on the Internet in the last 20 years. MIR was created by combining audio big data and Artificial

Intelligence (AI), and it has since become a key aspect of music technology. The incorporation of blockchain technology encourages the merging of music and technology. MIR is based on music acoustics, extracts audio characteristics using audio signal processing, and leverages a range of machine learning AI algorithms at the back end. MIR is now an important aspect of scientific study. The major academic conferences in the United States and internationally include ISMIR (International Conference on Music Information Retrieval), ICCM (International Conference on Computer Music), CCSMT (United Conference on Sound and Music Technology), and ICALSSP (International Conference on Acoustics, Language, Signal Processing).

II AN INTRODUCTION TO SCIENTIFIC RESEARCH IN MIR

The MIR area, when combined with blockchain technology, comprises hundreds of study subjects that may be separated into core-level MIR research and application-level MIR research based on their proximity to specific music parts. (figure 2)

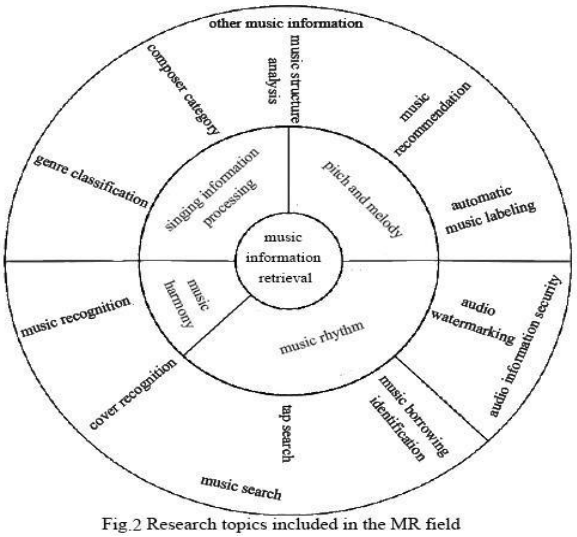

Fig.2 Research topics included in the MR field

A. Melody & pitch

Each note in music has a unique pitch that is defined by the frequency of the sound wave.

There are three types of pitch detection: (1) Time-domain detection, in which sound waves are analysed in time, specifically by using the zero-crossing method, auto-correlation method (such as the YIN algorithm), maximum likelihood method, adaptive filter method, super-resolution method, and so on; (2) Frequency domain detection, in which the signal is analysed in frequency using the short-time Fourier transform (STFT). The fundamental frequency of the time period is determined by the principle that the periodic signal has different peaks at integer multiples of the fundamental frequency, yielding the pitch; (3) Auditory model detection, that is, the pitch can be determined by simulating the physiological process of human pitch perception, performing independent autocorrelation calculations on each channel using the cochlea model, and synthesising all channel information

Melody is a musically constructed series of notes that expresses the music's goal in accordance with rhythm and harmony.

The method of extracting a monophonic melody from a polyphonic / polyphonic music signal is known as melody extraction. There are three common methods: pitch importance, singing voice separation, and data-driven note categorization. It may be used for music searching, plagiarism detection, vocal evaluation, composer style analysis, and so on.

B. Music Rhythm

The goal of Node Onset Detection is to determine the beginning time of a certain note in music. It is a phase in the pre-processing of different music rhythm analyses. On the waveform, a note can be represented as Onset (note beginning point) / Attack (note rising portion) / Transient (note continuous section) / Decay (note decay section) and other sections. The plucked string instrument is Hard Onset (hard note beginning point), and the conventional algorithm consists of multiple steps: subband decomposition, detection of each subband's energy peak, and selection result after combination. Stringed instruments have a soft start. It is possible to solve it by locating chord breakpoints..

Beat tracking is a method of imitating the occurrence of clapping or clapping while listening to music. It's also a necessary stage in many MIR activities. It often relies on the detection of note start points, percussion, or other time-localized events. You can utilise chord change points as alternative beat points if the song is more lyrical without percussion or is not evident.

Tempo Detection (Tempo Detection) is typically conducted concurrently with beat tracking. It is used to set the tempo of the song. It is commonly stated in BMP (Beats per Minute). It can be used to analyse music sentiments or to assist individuals with Parkinson's disease in regaining walking abilities. A traditional way is to use a band pass filter to calculate the amplitude envelope of each subband, then convolve it with a series of pre-defined comb filters and aggregate the energy over all subbands. The speed has the highest peak.

C. Harmony in music

Homophony has steadily superseded Polyphony since the second half of the 18th century, and harmony is one of the most significant parts of primary music.
The PCP (Pitch Class Profiles) or Chroma, which is the accumulation of octave-free spectral energy over twelve semitone classes, is the most essential audio characteristic in Chord Detection. Template matching, Hidden Markov Model (HMM), Conditional Random Fields (CRF), Support Vector Machine (SVM), and Recurrent Neural Network (RNN) are among the recognition models.

D. Processing information from sound

Singing or Vocal Detection The method of distinguishing which portions of a song are singing voices and which parts are pure instrumental accompaniment is known as voice detection. It mainly employs audio frame extraction to efficiently identify the singing voice from the accompaniment; machine learning is then used to classify the audio aspects of the performance, and ultimately, singular points are deleted using smooth post-processing.

Performer Identification, also known as Artist Identification, detects whose singer sings a song in a collection. The structure is similar to that of speaker or voice print recognition. Singing is vastly different from talking, which is technically more difficult. It can manage a vast number of songs and mimic performances by artist category.

The singing evaluation is divided into two sections. The fundamental evaluation involves determining the similarity of two singing voices' audio qualities such as loudness, pitch, rhythm, melody, vibrato, and so on. Emotion, range, sound quality, timbre recognition, vocal talents, and other factors are considered in the advanced examination. MIR technology has advanced significantly as a result of its integration with blockchain technology.

III. APPLICATION LAYER MIR RESEARCH

A. Music Retrieval

The method for identifying music is to record a music segment as a query, then calculate the audio fingerprint and compare it to the backdrop fingerprint database. Finally, the most similar recorded data will be returned, such as the song's title, songwriter, vocalist, lyrics, and other information.
You may use blockchain technology to declare ownership and number any genre of music in digital form with the inclusion of blockchain technology.
Querying by Humming or Singing is more difficult than music recognition because it involves recording a humming or singing voice as a query segment, then calculating the audio characteristics and performing similarity matching in the database, and finally returning the result list based on the degree of matching.Melody coding characteristics (such as pitch contour, interval, pitch, pitch change, pitch change, and so on) are commonly utilised for melody matching. Approximate string matching, dynamic temporal regularisation, editing distance, and invisible Markov models are among the matching approaches.
Multi-version music identification, also known as cover song identification, is used to detect whether two songs originated from the same source. The core melody is essentially the same, but the music structure, pitch, rhythm, backing music, vocalist gender, language, and so on might vary widely. In general, blockchain technology extracts reliable medium and high-level properties of music, and then matches the complete music or music fragments of each version.

B. Emotion Recognition in Music

Music emotion recognition (MER) combines psychology, musicology, and artificial intelligence (AI) technology. There are two technical approaches: one is to translate the MER to single-label or multi-label classification using the Hevner or Thayer emotion models, and the other is to decrease the two-dimensional Arousal and Valence (AV) emotion spatial regression prediction issue based on AV values. Music selection, film and television production, music recommendation, and music therapy all make extensive use of MER.

C. Genre Classification in Music

Music may be classified into pop, rock, jazz, country, classic, blues, hip-hop, disco, and other genres using blockchain technology's audio feature extraction and statistical categorization.

D. Composer Classification of Music

Reading a piece of music, analysing the intrinsic style of the audio data using audio characteristics and statistical classifiers (such as decision trees, SVM), and identifying the related composer information, which is frequently employed in music theoretical research.
In addition to the four types of applications listed above, there is Intelligent Instrument Recognition. Analysis of Music Structure [8] 625-636 Music annotation (Music Annotation / Tagging / Labelling) application research on song and lyrics synchronisation (Music Summary / Thumbnail Music Recommendation)

IV. INTRODUCTION TO RESEARCH TOPICS RELATED TO MIR

It does not cover algorithm creation, singing voice synthesis, audio watermarking, audio and video combining, and so on in classic MIR technology, specifically blockchain intervention technology. These technologies, we believe, are also highly essential components of music technology, which will be briefly explained next.

A. Composition via Automated/Algorithmic/AI

It refers to the use of computer technology in the making of music, in part or entirely, to decrease human involvement (or composers). AI composition generates music programmatically, typically using grammar expressed by probabilistic methods, artificial neural networks, rules-based symbol systems, constraint programming and evolutionary algorithms, Markov chains, stochastic processes, knowledge-based music system rules, blockchain technology, and the depth of recursion neural networks to predict time-domain melody.

B. Singing Voice Synthesis

IIt converts words into singing voices based on the musical score using formant parameter synthesis, sample synthesis, or waveform stitching synthesis, among other methods. It may be used in a variety of situations, including virtual singers, toys, practise singing, and tone conversion. The fundamental technology is given by the Spanish MTG, while a classic example is the "Hatsune Miku" sold by Japan's Yamaha.

C. Watermarking of audio

Watermarking in digital audio is a method that embeds unique meaning and readily retrieves information without compromising the original audio quality. The incorporated watermark is resistant to audio signal and synchronisation distortion in various time and frequency domains. This technology may be used for a variety of purposes, including copyright protection, broadcast monitoring, pirate tracking, content tagging, and more. Passive audio is included in audio forensics.

D. Audio and video combination

Human perceptual instincts tell us that we should strongly pursue cross-media technology research and development that blends audio and visual. Music visualisation, movie emotional event recognition based on film speed, and music sentiment are examples of typical uses. The audio and video numbers are then saved in the music industry repository using blockchain technology.

V. CONCLUSION

The present development of MIR technology confronts several challenges. Many digital music related to copyright cannot be disclosed, and various audio data are derived from specific occasions and objects, which are difficult to collect and label; from a signal standpoint, various musical instruments and singing voices form a harmony in pitch, a rhythm in time, and are coupled into a multilayered complex audio stream. This makes separation of processing difficult or impossible, affecting future applications.

With the fast expansion of India's economy over the last five years, societal demand for computer software, hardware, and Internet-based music technology items has skyrocketed. The steady maturation of blockchain technology, in particular, provides substantial technical support for the merging of music and technology. Fortunately, the number of scientific and engineering undergraduates who have had musical instruction since childhood is growing, giving potential people resources for the field's future development.

In general, the combination of art and technology is the current tendency in modern life. Music technology, whether from a technological or cultural standpoint, has great theoretical, application, cultural, and social values. Music technology will undoubtedly enter a wonderful age of progress in the near future.

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