

The Duality of Sound and Meaning: Exploring the Convergence of Lyrics and Melody in Songs Using Sentiment Analysis

Двойствеността на звук и смисъл: Изследване на сливане на текст и мелодия, използвайки анализ на чувствата

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Абстракт

Този доклад изследва взаимодействието между лиричното съдържание и музикалната композиция в дискографията на Тейлър Суифт, като анализира емоционалното изразяване в текстовете и мелодиите при преходите между жанрове. Еволюцията на Суифт през различни жанрове – от кънтри до поп, инди-фолк и алтернативна музика – представя уникален случай за изследване на влиянието на жанровите промени върху връзката между текстовете и музикалните елементи. Чрез анализ на настроеността на почти 300 песни и извличане на аудио характеристики чрез Spotify API, това изследване разглежда теми като любов, разбито сърце и себеоткриване. Резултатите подчертават динамичната роля на жанровите промени и новите записи в оформянето на емоционалното въздействие, като предлагат прозрения за разказвателното и музикалното влияние на Суифт.

Abstract

This paper explores the interplay between lyrical content and musical composition in Taylor Swift's discography, analyzing emotional expression in lyrics and melody across genre transitions. Swift's genre evolution—from country to pop, indie-folk, and alternative—presents a unique case for examining how shifts in genre impact the relationship between lyrics and musical elements. Using sentiment analysis on nearly 300 songs and audio feature extraction via the Spotify API, this study investigates themes like love, heartbreak, and self-discovery. Findings highlight the dynamic role of genre shifts and re-recordings in shaping emotional impact, offering insights into Swift's narrative and musical influence.

Ключови думи: Sentiment Analysis in Music, Emotion Detection Algorithms, Data-Driven Music Insights (до 5 думи)..

JEL: O33 – Technological Change: Choices and Consequences; Diffusion Processes: Covers the application of innovative sentiment analysis and NLP in analyzing music

Introduction

Background and Significance

The work of commercially successful artists like Taylor Swift presents a unique opportunity in data science. While traditional music analysis is well-developed, applying big data techniques to explore song lyrics is a

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newer approach. This project bridges that gap by employing sentiment analysis and data visualization tools to analyze the emotional depth within Swift's discography.

Swift's lyrics, touching on universal themes like love, loss, and self-discovery, provide a rich subject for sentiment analysis. This study combines quantitative methods and tools like Power BI to reveal emotional trends and variations across her work, offering insights beyond thematic content alone.

The relevance of this research is underscored by the rise of music streaming, with platforms like Spotify producing extensive data on audience engagement. In this context, sentiment analysis and engagement metrics offer valuable insights for industry decisions. Advances in AI and NLP make efficient lyric analysis feasible, while interactive data visualization enhances interdisciplinary collaboration in musicology, data science, and business intelligence.

Research Objectives and Hypotheses

Taylor Swift's work offers a rich subject for analysis, merging cultural, economic, and artistic elements. Her lyrics, celebrated for relatable themes, reflect her cultural influence and artistic vision. Economically, her success extends beyond music, bolstered by strategic partnerships and marketing, positioning her as a leading artist.

Interest in Swift's impact has surged, with courses on her work appearing at institutions like NYU, Harvard, and Stanford. Interdisciplinary conferences frequently showcase research on her influence, attracting scholars from economics, psychology, and music. This trend emphasizes her growing academic relevance. The concept of *kairos*—seizing the opportune moment—frames Swift's work effectively, allowing inquiries into knowledge, accessibility, and identity in popular music.

Objectives and Goals

This paper explores Taylor Swift's emotional landscape by analyzing the sentiment in both lyrics and melody. The primary objectives and tasks include:

1. Sentiment Analysis Model Development

The objective is to develop a model that classifies emotional tones in Taylor Swift's lyrics, aligning lyrical sentiment with melodic traits. This involves using a sentiment dictionary specialized for poetic language, alongside machine learning methods, to measure sentiment intensity within the lyrics. The model also assesses sentiment trends by incorporating key melodic factors such as tempo and chord progression to provide a comprehensive understanding of how lyrics and melody interact to convey emotional expression.

2. Integration of Melody Sentiment Analysis

The objective is to extend sentiment analysis to include melodic elements, examining their influence on overall song sentiment. Key tasks involve identifying specific melodic markers, such as key and tempo, that

correlate with lyrical sentiment, as well as quantifying emotional traits in melodies. This allows for an exploration of how melody and lyrics interact, assessing whether they create coherence or contrast in emotional expression.

3. Power BI Visualization Application

Building on a pre-existing Power BI tool, this study visualizes the interplay of lyric and melody sentiment in Swift's work. The interactive tool allows users to explore sentiment by album, theme, and emotional intensity.

4. Knowledge Extraction

The objective is to identify emotional patterns by analyzing relationships between lyrical and melodic sentiment alongside audience reception. Key tasks include correlating song sentiment with measures of popularity or critical acclaim and examining shifts in sentiment over time, offering insights into Taylor Swift's evolving artistic voice.

Expected Contributions

The research will provide insight into the combined emotional impact of lyrics and melody, highlighting patterns in Taylor Swift's approach to conveying sentiment. By integrating melodic analysis with lyrical sentiment, this study aims to reveal how lyrics and melody interact to shape listeners' emotional responses, offering a novel perspective on sentiment analysis in popular music.

Literature Review

Sentiment Analysis in Music

Sentiment analysis for textual data leverages various sentiment lexicons and tools to categorize emotions, with popular models like Vader and SentiArt being widely used. Vader, known for its effectiveness with social media text, assigns polarity to words, enabling straightforward categorization of emotions in text. SentiArt extends these capabilities to more artistic forms, applying sentiment analysis in a nuanced way suitable for poetic and literary texts. However, standard lexicons and sentiment analysis methods face challenges when analyzing song lyrics due to frequent metaphor and non-literal language, which can lead to misinterpretations of complex emotions embedded in figurative expressions. These limitations underscore the need for methods that capture deeper layers of emotional expression unique to music and lyrical contexts.

Music Theory and Emotion

Foundational theories in music suggest that musical elements like tempo, key, and harmony directly affect emotional conveyance, with specific structures (e.g., minor keys for sadness or slower tempos for calm) widely recognized for their emotional impact. Research on genre-specific attributes has shown that genre influences emotional responses; for instance, rock may evoke excitement, while classical music is often linked with tranquility. Genre shapes listeners' expectations and emotional engagement, with distinctive characteristics that evoke different responses across cultural and social contexts.

Previous Studies on Lyrics and Melody

Past studies have typically focused on analyzing lyrics and melody separately, with lyrical analyses concentrating on themes and sentiment, while melody studies focus on musical structure and its psychological effects. Although these analyses have yielded important insights, they highlight the need for integrated approaches that consider both lyrics and melody in understanding music's overall emotional impact. By combining sentiment analysis of lyrics with musical features, future studies could achieve a more holistic understanding of emotional expression in music.

Methodology

Dataset

1. Data Collection:

- **Spotify Dataset:** The Taylor Swift Spotify dataset on Kaggle, sourced from Spotify's API, contains data on her albums available on the platform. Columns include song name, album, release date, track number, and song-specific metrics (e.g., danceability, energy, acousticness, instrumentality, and popularity).
- **Genius Dataset:** This dataset offers discography details from Genius, such as album titles, track numbers, release dates, page views, song lyrics, and lists of contributing artists, writers, producers, and genre tags.
- **Awards List:** Sourced from Wikipedia, this includes data on Taylor Swift's awards and nominations.

2. Data Cleansing in Excel

3. Final Dataset Structure:

After merging datasets, additional columns were computed in Excel for duration grouping and award metrics, resulting in a dataset of 299 rows and 25 columns.

Sentiment Analysis of Lyrics

Data preprocessing involves critical steps to ensure the quality and usability of the collected data. This process includes implementing various data-cleaning techniques tailored specifically for song lyrics, such as removing irrelevant words or phrases (e.g., "verse," "bridge," or repetitive syllables like "woah-woah") and addressing formatting discrepancies across datasets. Maintaining consistent formatting across different data sources is vital for seamless integration and analysis.

Sentiment analysis will leverage SentiArt, a library designed for literary and poetic texts, which is particularly suited for song lyrics. It analyzes text using vector models to capture sentiment "valence," encompassing a range of emotional indicators. SentiArt yields seven distinct metrics: overall sentiment (from -1 to 1), anger, fear, disgust, happiness, sadness, and surprise, providing a nuanced emotional profile for each song.

Effective visualization techniques, including word clouds to highlight frequently used words, will be employed to clearly present the insights derived from this comprehensive analysis.

Audio Feature Extraction

Data enrichment will involve incorporating Spotify API. This allows for a broader analysis that connects sentiment scores with musical attributes, revealing patterns between song composition and emotional expression, while also facilitating essential melody analysis through extracted audio features.

- **Tempo:** Measures the song's speed in beats per minute, indicating its overall energy and pace.
- **Key:** Identifies the musical key, providing context for tonal and harmonic structure.
- **Mode:** Defines the scale as either major (often associated with positive emotions) or minor (commonly linked to somber or intense feelings).
- **Loudness:** Represents the average decibel level, contributing to the song's perceived energy and intensity.
- **Valence:** Reflects the positivity or negativity of the track's musical tone, useful for assessing the song's emotional feel.
- **Danceability:** Assesses how suitable a track is for dancing based on rhythm, beat, and tempo, often linked with higher energy songs.
- **Energy:** Captures the intensity and activity level, correlating with elements like tempo and loudness to indicate excitement.
- **Liveness:** Measures the probability of a live audience presence, adding context for acoustic or studio effects.

Each feature provides a unique perspective on the musical composition's emotional and rhythmic qualities, enabling comparisons with lyrical sentiment scores to reveal any alignment or contrast between melody and lyrical themes.

Once extracted, these audio features are categorized to enable direct comparison with lyrical sentiment scores. For instance, tempo and loudness can be grouped into "energy" indicators, whereas valence and mode can be viewed as "emotional tone" indicators. This categorization facilitates a comparison framework, where sentiment analysis results (from SentiArt) are matched against corresponding audio attributes to uncover correlations—such as whether upbeat tempos align with positive lyrical content. This approach aims to reveal relationships between a song's musical and lyrical elements, offering a more comprehensive view of its emotional impact.

Results

Sentiment Patterns in Lyrics

After the analysis of just the word clouds of each album – including the rerecordings – the key conclusions can be made sealed with data:

- **Consistent Themes Across Albums:** Since her first album, Swift has used recurring words like "back," "time," "love," "eye," "girl," "heart," "home," "baby," and "wanna." These words remain central throughout her entire discography, hinting at ongoing themes in her work.

- **Impact of Album Re-recordings:** The re-recorded albums show a slight shift in word emphasis, but the core vocabulary remains similar. New "vault" tracks added to these albums align well with each album's original themes, preserving the original mood.
- **"Sister Albums" Contrast:** Her "sister albums," particularly *evermore*, reveal a darker tone, with words like "dead" and "alive" becoming prominent for the first time. This marks a noticeable thematic shift in her work.
- **Unexpected Similarity in Contrasting Albums:** Despite their distinct reputations, *Reputation* and *Lover* share similar word connotations, showing surprising thematic overlap.
- **Introduction of Explicit Language:** In her eleventh album, a shift appears with the first use of strong language (the word "fuck") appearing in the top 15 most-used words.
- **"Love" as a Dominant Theme:** Across every album, the word "love" consistently ranks in the top 10, underscoring its enduring importance in her lyrics and emotional narrative.

Taylor Swift's discography reflects evolving patterns in liveliness, tempo, and energy, shaping each album's emotional and genre distinctions:

1. **High Tempo in Early Albums:** *Taylor Swift* and *Fearless* feature high tempos and liveliness, emblematic of themes like young love and optimism, with tracks such as "Love Story" and "You Belong With Me" embodying the energetic, youthful tones of early country-pop.
2. **Balanced Dynamics in Middle Eras:** Albums like *Red* and *1989* show varied tempo choices. *Red* oscillates between pop energy ("22") and introspective ballads ("All Too Well"), while *1989* maintains a controlled liveliness with upbeat tracks like "Shake It Off" alongside slower, atmospheric songs like "This Love."
3. **Subdued Tempo in Folklore and Evermore:** In *Folklore* and *Evermore*, Swift adopts a slower tempo and lower energy, producing a reflective, ambient tone focused on lyrical depth. Tracks such as "cardigan" and "exile" showcase folk-inspired, introspective melodies.
4. **Energetic Return in Reputation and Midnights:** *Reputation* introduces intense, high-energy tracks ("...Ready for It?" and "Look What You Made Me Do") with controlled, assertive beats, matching its darker, defiant themes. *Midnights* combines high-energy pop with moody synths, enhancing rhythmic dynamism.
5. **Danceability and Rhythm Innovation:** Albums like *Lover* and *Midnights* emphasize dance-pop elements, with inviting tempos and rhythms aimed at broader pop audiences, signaling a shift from her more lyrically focused work.

These shifts in musical features underscore Swift's versatility, with each era's dynamics reinforcing the emotional and thematic essence of the albums.

Convergence of Lyrics and Melody

The convergence of lyrics and melody is a defining feature of Taylor Swift's songwriting, where each element enhances the other to create a profound emotional impact. Swift's ability to weave intricate

narratives into her melodies allows her songs to resonate deeply with listeners. Her lyrics draw from personal experiences, rich with relatable themes of love, loss, and self-discovery.

In her early works, such as *Taylor Swift and Fearless*, the lyrics are straightforward and paired with catchy melodies that reflect youthful optimism. For example, "Love Story" uses a simple melodic structure that mirrors its fairy-tale narrative, creating an anthem of hope. As her career progresses, especially in *Red* and *1989*, Swift explores more complex themes. The melodies in songs like "All Too Well" and "Blank Space" shift between reflective and energetic passages, reinforcing the emotional highs and lows.

In her recent work, particularly in *Folklore* and *Evermore*, the convergence of lyrics and melody adopts a more subdued approach. The melodies reflect an introspective mood, enhanced by softer instrumentation that deepens her storytelling.

Ultimately, Swift's skillful marriage of lyrics and melody elevates her artistry to a level of profound significance. This intricate interplay not only illustrates her growth as an artist but also establishes her as a master of emotional resonance in music. Through recurring musical motifs and thematic continuity, Swift creates a cohesive thread that unifies her albums, inviting listeners to engage with her work on multiple levels. Her ability to evoke powerful emotions makes her songs both relatable and enduring, solidifying her status as a pivotal figure in contemporary music.

Case Study

Public Perception vs. Sentiment Analysis

Overview: This case study investigates the discrepancies between sentiment analysis results and public perception for selected Taylor Swift songs, including "**You Need To Calm Down**," "**Sparks Fly TV**," and "**Evermore**." These songs show varied emotional classifications that reflect differing listener experiences.

Analysis:

1. Song Details:

- "You Need To Calm Down": While classified as neither sad nor happy, the lyrics serve as a critique of societal negativity, showcasing a sarcastic and assertive tone. Public perception aligns with this analysis, viewing the song as a call for self-reflection.
- "Sparks Fly TV": Initially seen as a romantic track, its aggressive undertones lead to classification as angry. However, many fans interpret it as a celebration of passionate love, creating a divide between sentiment analysis and listener sentiment.
- "Evermore": Classified as sad, the lyrics convey deep emotional struggles and longing, yet many listeners find a sense of hope intertwined with the sorrow, further complicating its classification.

2. Discrepancies:

- The differences in classification arise from the subjective nature of music interpretation. While sentiment analysis might focus solely on language, public perception often includes emotional resonance and personal experiences.

Conclusion: The contrast between public perception and sentiment analysis reveals the importance of context and emotional nuance in understanding music. This case study advocates for combining analytical methods with qualitative listener feedback to achieve a comprehensive view of emotional impact.

Discussions

Interpretation of Results

The analysis of Taylor Swift's music reveals significant insights into the complexity of her songwriting. A primary finding is her nuanced use of language, marked by metaphorical depth. This complexity complicates categorization, as in tracks like "This Love" and "Happiness," where layered emotions challenge automated sentiment tools that rely on simpler, binary classifications. Her albums also display thematic continuity across contrasting aesthetics. For example, *Lover* and *Reputation* explore love and relationships through distinct perspectives, weaving intricate emotional threads that resonate deeply with listeners.

Limitations

There are, however, limitations in this analysis. Swift's use of metaphor can hinder sentiment algorithms, potentially leading to misclassification. Additionally, music perception varies, with listeners often interpreting lyrics differently, making universal emotional categories difficult to establish. Relying on external data (e.g., Spotify API) to assess emotional valence also has limitations. While valence suggests a song's mood, it may not fully capture its emotional layers.

Future Research Directions

Future research could include qualitative analyses of Swift's lyrics to explore the depth of emotions and context. Advances in natural language processing (NLP) could improve sentiment analysis by better interpreting metaphorical language. Further, examining how musical composition interacts with lyrics to shape emotional perception could deepen our understanding of the emotional impact of her music. Ultimately, this analysis highlights the complexity of Taylor Swift's music, underscoring the need for interdisciplinary exploration that embraces both linguistic intricacy and musical composition.

Conclusion

In conclusion, this analysis of Taylor Swift's artistic evolution—from a teenage country star to a globally recognized pop icon, and her subsequent transition into a folk storyteller—offers substantial insights into her creative transformations. By examining her discography as distinct eras, the study reveals the profound emotions embedded in her lyrics, the variations in musical genre, and the shifting societal sentiments that underscore her remarkable success as an artist, songwriter, and cultural figure.

Integrating sentiment analysis with lyrical interpretation, along with utilizing Spotify API data to assess the success of each era, contributes to a comprehensive exploration of Swift's career trajectory. The incorporation of SentiArt, a contemporary sentiment analysis tool, enhances our understanding of the emotional nuances within her music. Autobiographical lyricism serves as the foundation of her

communication with fans; since the inception of her career, Swift has shared personal experiences through her art.

Her progression toward multidimensional storytelling in her later works, coupled with her exploration of various musical genres, facilitates an audience that evolves alongside her. Ultimately, this research highlights the potential for advanced data analysis tools like SentiArt to revolutionize our understanding of music, offering insights into trends and enhancing personalized music recommendations. As Swift aptly states, "I see music in my head as colors and emotions," encapsulating the essence of this research focused on illuminating the emotional landscape of her musical journey.

References

This scientific paper builds upon the author's master's thesis project, synthesizing the information gathered during that research while also presenting additional insights not included in the original project documentation. It offers a comprehensive analysis of the findings, enhancing the understanding of the subject matter through a more rigorous examination of the data and conclusions drawn in the thesis.

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