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From Words to Music: A Generative AI Approach for Scenario-Driven Music Composition

Aditya Misal[1], Sanidhya Patil[2], Parth Kale[3], Raviraj Rananvare[4], Aditya Rai[5], Dr. Riyaz A. Jamadar[6]

AISSMS IOIT, Pune

A B S T R A C T :

In recent years, advancements in generative artificial intelligence (GenAI) have enabled novel applications in creative domains, including automatic music composition. This paper presents an innovative framework for **Automatic Music Generation from Textual Scenarios** using GenAI. The system is implemented as a Python Flask-based web application, where users can input descriptive scenarios (e.g., "calm beach vibe" or "dramatic suspense"). Leveraging the OpenAI API, the system converts these scenario descriptions into structured musical elements such as tempo, mood, instrumentation, and style. Subsequently, these structured elements are transformed into MIDI files, which are synthesized into audio using software synthesizers like FluidSynth, providing an interactive music experience for users.

This study explores the technical aspects of combining natural language processing with audio synthesis, detailing the integration of generative text models with MIDI-based music generation. The proposed framework offers flexible, on-demand music generation for personalized scenarios, serving as a versatile tool for creative, educational, and therapeutic applications. Experimental results show that the system can produce diverse musical outputs based on a wide range of scenario inputs, opening up future possibilities for GenAI in automated composition and interactive audio experiences.

Keywords: Automatic Music Generation, Generative AI, Audio Synthesis, Scenario-based Composition, OpenAI API, MIDI Generation, Text-to-Music, Python Flask, Interactive Music, FluidSynth.

1. Introduction

Music has long been a domain of human creativity, emotion, and expression. With recent advancements in artificial intelligence, it is now possible to leverage technology to generate music that resonates with specific moods, themes, or scenarios. Generative AI (GenAI) has opened new frontiers in the automatic generation of music, allowing for innovative applications across industries such as entertainment, education, therapy, and even personalized user experiences. By converting descriptive scenarios into music, we can create soundscapes that respond to user input in a meaningful way, further bridging the gap between artificial intelligence and artistic creation.

Traditional methods for music generation have relied on predefined patterns, styles, or rule-based systems. However, recent developments in deep learning and natural language processing allow for a more flexible and creative approach, where AI models generate music based on open-ended descriptions. In this work, we introduce a novel approach to **Automatic Music Generation from Textual Scenarios**, utilizing the OpenAI API to interpret user-provided scenarios and convert them into structured musical characteristics such as tempo, key, mood, and instrumentation. These structured characteristics are then transformed into MIDI files, which are synthesized into high-quality audio using tools like FluidSynth, providing an accessible, real-time experience for users via a web interface.

The system is designed as a Python Flask-based web application, enabling users to easily input descriptive scenarios, such as "a calm beach evening" or "tense thriller chase," and receive audio compositions aligned with their descriptions. This framework combines AI-driven text generation with MIDI-based music synthesis to create a versatile platform capable of producing unique compositions in real time. Such a system has the potential for a wide range of applications, including use in filmmaking, game development, mental health therapy, and personal entertainment.

This paper explores the technical foundation of the project, detailing how descriptive text is transformed into music through generative AI models and audio synthesis tools. By blending natural language processing and music synthesis, our work demonstrates the potential of GenAI in automated music composition, paving the way for innovative applications in human-computer interaction, digital art, and personalized sound creation. We also discuss the challenges encountered, including ensuring musical coherence and capturing nuanced emotions, and propose solutions to improve the system's effectiveness.

2. Related Work

The field of automatic music generation has seen significant advancements, primarily driven by developments in deep learning, generative models, and audio synthesis technologies. Early music generation systems relied on rule-based approaches and algorithmic composition, where predefined rules or templates guided the creation of musical sequences. However, these methods lacked the flexibility and creativity found in human compositions, as they were constrained by rigid structural rules. Recent breakthroughs in generative artificial intelligence (GenAI), particularly through models such as recurrent neural networks (RNNs), variational autoencoders (VAEs), and generative adversarial networks (GANs), have paved the way for more nuanced and expressive music generation.

One prominent area of research has focused on **MIDI-based music generation**. Google's **Magenta project** has made significant contributions with models like MusicVAE and MelodyRNN, which can generate musical sequences based on user-provided inputs, such as melodies or rhythm patterns. These models use a combination of RNNs and VAEs to create variations of musical themes, offering a foundation for MIDI-based music generation. Magenta's tools have proven effective for generating sequences that maintain coherence over time, though they are limited in terms of capturing complex user-defined emotions or detailed scenarios.

MuseNet and **Jukebox** by OpenAI have also contributed to music generation by extending the capabilities of large-scale generative models. MuseNet, a 72-layer deep neural network, is capable of generating four-minute compositions with ten different instruments, while Jukebox is trained to produce raw audio based on genre, artist, or mood. MuseNet uses transformer architectures, enabling it to create coherent musical compositions across genres. However, MuseNet and Jukebox are resource-intensive, and Jukebox's raw audio output limits its real-time applicability in web applications. Moreover, both models lack the flexibility for on-the-fly generation from user-provided scenario descriptions, which our system aims to address.

Scenario-driven music generation, where text descriptions are used to guide the mood, tempo, or style of the music, remains a developing area of research. While some AI music systems attempt to match specific emotions, there is limited work on directly translating descriptive scenarios into structured musical compositions. Natural language processing (NLP) techniques have been used in text-to-music generation research, such as in **AIVA (Artificial Intelligence Virtual Artist)**, which composes music based on predefined styles and themes. AIVA's primary application has been in soundtracks and background music, but it does not allow for free-form scenario inputs as our proposed system does.

In the realm of text-to-music conversion, **FluidSynth** and **Timidity++** have been widely used for MIDI-to-audio synthesis, allowing MIDI sequences to be converted into high-quality audio using SoundFont libraries. These synthesizers provide flexibility in rendering digital instruments, making them valuable tools for converting generated MIDI files into WAV or MP3 formats. However, these tools alone do not offer scenario-based or AI-driven generation and require external MIDI input, which our system generates automatically through scenario interpretation.

Our work builds on these foundations by integrating NLP-driven scenario interpretation with MIDI-based music generation and synthesis. By allowing users to input descriptive scenarios, we aim to produce tailored musical compositions that respond to user intent, thus addressing a gap in existing systems that either focus solely on fixed patterns or predefined themes. This project advances the field of AI-driven music composition by combining text-to-music transformation, MIDI synthesis, and web-based interactivity to create a comprehensive, scenario-based music generation framework.

3. Methodology

The The proposed system for **Automatic Music Generation from Textual Scenarios** combines natural language processing, generative modeling, and audio synthesis to translate user-inputted scenarios into musical compositions. The system is implemented as a web application using the Flask framework, allowing users to input descriptive text (scenarios) that describe the mood, setting, or style they wish to capture in the music. The methodology is divided into four primary stages: scenario processing, music characteristic generation, MIDI creation, and audio synthesis.

1. Scenario Processing

Upon user login, the system prompts users to input a descriptive scenario. This text description, such as "calm sunset on the beach" or "intense thriller scene," serves as the primary input, which needs to be converted into structured musical parameters.

- **Natural Language Processing**: The OpenAI API is utilized to process the user's scenario input. A prompt template is crafted to guide the API in translating free-form text into key musical characteristics, including tempo, key, style, instrumentation, and mood. For example, a calm or serene scenario may suggest a slower tempo, a major key, and softer instrumentation (e.g., acoustic guitar, strings), while an intense scenario may call for a faster tempo, minor key, and heavy percussion.
- **Response Parsing**: The API's output is parsed to extract key musical characteristics. This structured output serves as the basis for generating the musical composition.

2. Music Characteristic Generation

After parsing the OpenAI API response, the system defines musical parameters that will dictate the MIDI sequence. These characteristics include:

- **Tempo**: The beats per minute (BPM) suggested by the scenario, with slower tempos for calm scenes and faster tempos for action or suspense.
- **Key and Scale**: The harmonic foundation of the composition, often inferred from mood (e.g., major for uplifting scenarios, minor for somber or intense scenes).
- **Instrumentation**: A selection of instruments based on the mood and style, which determines the MIDI channels used for each instrument.

- **Melodic and Harmonic Patterns**: Based on the input, basic chord progressions and melodic lines are generated to create a cohesive musical structure. For instance, the system may select arpeggiated patterns for tranquil settings or staccato for energetic scenes.

3. MIDI Creation

Using the structured musical characteristics, the system generates a MIDI file that embodies the user's scenario. This stage involves:

- **MIDI Programming**: Python libraries such as **PrettyMIDI** and **Mingus** are used to create MIDI sequences based on the extracted musical attributes. Notes, chord progressions, and rhythmic patterns are generated programmatically.
- **Layering and Arranging**: The MIDI structure includes layers of different instruments and rhythms, where each track represents an instrument (e.g., bass, melody, chords) that contributes to the overall sound.
- **File Export**: The MIDI file is saved temporarily on the server, ready for the next stage of processing.

4. Audio Synthesis

To convert the MIDI file into a high-quality audio file, the system utilizes a software synthesizer, enabling the final musical output to be played and downloaded.

- **MIDI-to-Audio Conversion**: **FluidSynth** is used for synthesizing the MIDI file into an audio format (e.g., WAV or MP3). FluidSynth reads the MIDI data and uses a SoundFont library to simulate realistic instrument sounds.
- **SoundFont Selection**: The system selects SoundFonts that match the desired instrumental timbres. For example, a scenario indicating classical or orchestral music may use a SoundFont that includes string and brass samples, while a contemporary scenario may use synthesizers or electric guitars.
- **Audio File Export**: The synthesized audio file is saved in a downloadable format, allowing the user to listen to the generated music directly from the web application.

System Architecture

The overall system architecture is designed to handle real-time user requests and generate responses with minimal latency. Flask serves as the backend for handling HTTP requests, managing user sessions, and invoking the OpenAI API and FluidSynth synthesizer. The frontend is a responsive web interface where users input scenarios and receive generated audio output. The Flask server facilitates communication between the OpenAI API for text processing and FluidSynth for MIDI-to-audio conversion, ensuring seamless integration between components.

User Experience Flow

1. **User Registration and Login**: Users register or log in to the web application, establishing a session.
2. **Scenario Input**: After logging in, the user is prompted to describe a scenario.
3. **Music Generation**: The system processes the scenario, generates a MIDI file, and synthesizes it into audio.
4. **Audio Output**: The user can listen to the audio directly in the browser or download the file.

Conclusion of Experimental Results

In conclusion, the experimental results validate the effectiveness of the *Oral Cancer Detection Using Deep Learning* system. The promising performance metrics and positive user interaction outcomes indicate that the system has significant potential to assist in the early detection and management of oral cancer, ultimately improving patient care. Future work may focus on expanding the dataset, incorporating additional features, and validating the model in real-world clinical environments.

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