Program for Synthesizing Arrangements for Musical Compositions

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***Abstract*—In recent years, there is an increase in popularity of music as a hobby, as instruments and educational content on this topic has become more accessible. A large number of people study music with the goal of composing their own music. Often, a composer, who came up with some musical ideas, struggles to develop them into more complex composition. This paper proposes a program, which will help beginner musicians in composing arrangements. The main goal of this program is to synthesize parts of the arrangements, based on provided by the user melodies, in order for user to get inspiration from.**

Keywords—music; arrangement; synthesizing; sound;

INTRODUCTION

Most modern music consists of main theme [1] (or multiple themes), and it's variations, which are played as composition is developed. For example, a composer can take a melody, and change time between each note played, so it is still recognizable for a listener, but in the same time brings something new. There is a great quantity of different techniques, which can be used to diversify musical composition, like modulating a melody into a different mode for a different mood, adding or deleting notes, and a lot more. Due to the specifics of musical composition, there is no algorithm, which can be used to generate perfect composition, since it's every aspect is subjective to the listener. However, some of techniques, like ones described above, can be modeled and their generation can be automated.

Usually, the process of composing contains a phase of generating and sorting through the variations of the main theme. A composer can try different known techniques, play random notes, until it sounds good, or consult other people, like members of the band. The idea of the program for synthesizing arrangements for musical compositions is to take part a role of other people to consult with.

Proposed application will be used to generate variations of provided musical idea. This application will consist of mobile application and a server, which will be used for making calculations and storing user's projects. There will be a number of modes, in which a program will generate parts of musical composition for different instruments, which will be displayed on the screen and played with the help of virtual instruments. User will be able to save best parts or generate more, and export them as sound or in midi format [2], for usage in other music-related software.

This paper is organized in next sections: introduction, literature review, methods, results and conclusion.

LITERATURE REVIEW

The idea of automatically generated music has existed long before computers were invented. As an example, Musikalisches Würfelspiel or musical dice games existed in the 18th century, one of which was attributed to Mozart [6].

Despite the many breakthroughs, issues such as the musical tasks targeted by different machines and the degree to which they succeed remain open question [3]. However, there is a wide range of technology, which generates music for different purposes, that can be useful with the human guidance. With the development of information technology, models of several musical styles were invented. Those models were used in a wide range of algorithms to generate music in a certain style [5].

For instance, technology proposed in paper [4] is aimed to solve a problem, similar to the problem in this paper. That paper describes a system which generates variations on theme music fitting to story scenes. It varies melodies, tempos, tones, tonalities, and accompaniments of given theme music based on impressions of story scenes, a similar approach will be used in the proposed application. However, technology in paper [4] takes texts and pictures as input information. The present system consists of two sections, a musical image acquisition (MIA) section and a theme music transformation (TMT). The MIA section converts information on story scenes into transformation image parameters (TIPs) by modular neural network (MNN) models. The TMT section transforms inputted original theme music based on values of TIPs, and generates a set of midiformatted [2] candidates of variations on theme music for each story scene [4]. Proposed in this paper program will have different MIA, but TMT section can be studied for modification and application in the final product.

TMT section uses genetic algorithms meta-heuristic for transforming given music theme, which is represented as a chromosome in the framework of genetic algorithm. New synthesized melodies are evaluated using a fitness function, which evaluates how well it matches the mood, given as the input in the MIA section. In this case, neural networks are implemented and trained on test data. The results of the experiments, described in paper [4] show that the system transforms a theme music reflecting user's impressions of story scenes.

One of the problems of synthesizing music is coherence of melodies. According to multiple studies, new melodies should contain repeated parts or be related in a different way to other melodies in the context of musical composition. Some studies compare music and linguistics [7].

Another paper [5] presents a music generation method that generates coherent melodies using a melodic coherence structure extracted from a template piece and statistical models for evaluating generated sequences. Coherence structures describe relations between similar segments of a template piece.

This method changes both melodic and rhythmic information independently from each other, which is why two coherence structures and two statistical models should be generated: one pair for melody and another for rhythm generation. For both generations a stochastic hill climbing optimization process has been used, which starts with a random sequence and iteratively changes random positions to improve its probability according to a statistical model, always respecting the coherence structures.

In order to encode a template piece for analysis, two viewpoints (a function, that map a sequence to another sequence) are used. Viewpoint for melodic information consists of pitches of the notes, intervals between adjacent notes, intervals module 12 (12 semitones make an octave – interval, in which notes sound the most similar, except unison), contours of melodic movement (up or down), and more complex contours, which computes whether the contour between two contiguous notes goes more than a scale step down, goes one scale step down, goes more than a scale step up, goes one scale step up, or stays equal. Viewpoint for rhythmic information consists of durations of the notes, relation between durations of neighboring notes and contours, which compute, whether next note is shorter or longer. [5]

Viewpoints, described above are used to construct coherence structures, as a result of discovering patterns in the template piece. In this method, patterns are defined as sequence of viewpoints, and a pattern is recognized in a given composition, if it is repeated multiple times. Notably, some patterns can contain other patterns. In this case, while in generation phase, more deeply nested patterns are randomized first. [5]

Since this approach manages generation of new melodies and rhythms independently, it can be used in the proposed in this paper program as two different features user can apply when needed. Moreover, described in paper [5] method can be studied for modification in order to generate other types of musical information, for instance – to produce a sequence of chords, which will complement the melody.

Methods

Proposed program will use variety of different technologies to provide user a set of tools for synthesizing different parts of musical arrangements.

The pool of features will include:

1. Generation of chords, that match the melody, as well as order and speed of arpeggios of those chords,
2. Finding harmonical mistakes in the melody, given it is written in a certain mode,
3. Changing modes of the melody to achieve a different mood, generating variations of the melody, which will change notes, rhythms and volume dynamics,
4. Synthesizing rhythm parts for drums, which will complement the melody

Knowledge-based, statistics-based and other types of algorithms, such as sited above will be studied in order to develop and implement needed tools.

Results

Developed algorithms will be implemented in a form of client-server program, which consists of a mobile application for devices that support IOS, and a server, which deals with computations and storing user's data.

Mobile application will offer graphical user interface, which will allow user to enter initial melody and apply variety of algorithms. Input and output of the program will be displayed in piano-roll [8], as it is widely used in a large portion of digital audio workstations. In addition, user will be able to edit melody, select regions and move them along the time line. Resulting transcription of initial melody and other information, generated by the program, can be saved in a file. Finally, mobile application will have a feature to play generated music with the help of virtual instruments, and export it in audio or midi files, for future use in other software.

Server side of proposed application will apply algorithms to melodies, provided by mobile application via HTTP protocol [9]. This approach allows to avoid limitations of user's hardware and makes updates easier, because it does not rely on stores to be distributed to users.

Conclusion

With more accessible instruments and educational courses and materials, popularity of music as a hobby has risen, and big fraction of people study music to compose their compositions. Some parts of the composition process can be automated, such as generation of random variations of provided melody. Models of such algorithms can save time or give ideas, that user could not come up with.

Proposed application will provide convenient interface for a wide range of algorithms, that can provide user with different variants of parts of arrangement for inspiration. With the help of this application, user can find missing part of the arrangement when one is stuck and cannot come up with something that will fit, or focus on composition's overall structure.

In addition, proposed application will provide a storage for projects and additional features, like exporting synthesized parts, in order to make the process of composing and recording music more convenient.

While application is aimed to beginner musicians, it can also be useful by professionals as well.

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