AI-assisted Piano Music Composition: Innovative Approaches and Practical Explorations

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Abstract: AI-assisted can save the cost and time used in piano music composition, and AI composition techniques are categorized into deconstruction, classification, and reconstruction, as well as three common models. In this paper, Markov model is chosen to compose piano music, describing pitch and duration, level, note duration, converting key and duration, and establishing piano melody, harmony and rhythm Markov modeling process. Setting up the test server and experimental software to train the Markov model so that it generates new piano music and completes the creation of piano music. The analysis shows that the piano music created by AI is more in line with the user's needs, the melody of AI piano music is more attractive can score about 8.3 points, and 86% of the users think that the piano melody created by AI is more fluent, at about 8.3 points. It has a high degree of emotional expressiveness and recognizability, and can meet the public's music aesthetic, so that the listener has a sense of immersion.
Keywords: AI-Assisted; Piano Music Composition; Markov Model; Piano Melody; Music Aesthetics

1. INTRODUCTION

Due to the current rapid development of AI technology, it is gradually entering into various fields, and even merging with art to imitate and create works that surpass human beings. Piano has always been a bridge between composers and listeners with its rich expressiveness and cultural heritage, attracting a large number of people. However, with the development and breakthrough of AI technology, the use of AI technology to create piano songs has become the current mainstream (Liu et al., 2022; Pereverzeva, 2021). AI technology can analyze and imitate the music by using deep learning and big data methods to generate new piano songs. And AI technology can analyze the style and form of music, so as to infer the composer's intention and inspiration, and create beautiful piano songs (Li, 2023; Tigre Moura et al., 2023). The creation of AI technology not only enriches the diversity and innovation of music works, but also interacts with the creator, adjusts according to the feedback, and constantly optimizes the music, which provides a new way and manner for the fusion of music and science and technology, and pushes the development of the music development of the field, which has high research value and practical value (Darvish & Bick, 2024). In recent years, due to the rapid development of AI technology, it has been widely used in the field of music composition to participate in the creation and arrangement of piano music, so as to reduce the cost and time needed for composers to create music, and to make the style of piano music richer and more diverse. This paper first analyzes the development and characteristics of AI composition technology, and concludes that the process of composing with AI technology is similar to the reconstruction of data, which is to analyze and learn from the original music, so as to recompose new music. Secondly, the Markov model is used to compose piano music, which describes the notes and modes in the piano music to facilitate the subsequent composition. Finally, the Markov model is trained to learn the styles and melodies of other music, thus generating new music. In this way, it enhances the innovation and diversity of piano compositions, promotes the development of piano composition, reduces the composer's pre-preparation work, and reduces the time and cost required for composition. Improves the interaction between humans and AI, making the creation of music more complete and avoiding similarities with imitation tracks. Make the generated piano songs unique and novel, in line with today's market, attract a large number of people to pay attention to piano songs, promote the combination of the music field and AI technology, and make a positive contribution to the development of the music field.

2. RELATED WORKS

In using AI technology to create piano music repertoire, Xu, N. et al. used fuzzy clustering algorithm, designed sensor network related devices, combined the two, and designed a piano music creation model using artificial intelligence technology. According to the experimental analysis, when the number of neighbors is increased, the average absolute error and the mean square error of the collaborative filtering and fuzzy C-mean clustering algorithms show a decreasing trend. And when the number of neighbors is the same, the filter matching algorithm has a larger average in the mean absolute error and mean square error, which indicates that the error of the music created by the model is within a reasonable range (Xu & Zhao, 2021). Jun, M. et al. firstly converted the MIDI music format file into digital data and used the logistic fitting method to unfold the fitting of the time series to obtain the law of the temporal distribution (Jun et al., 2022). Secondly, the tones of the music were processed using MC simulation to obtain the distribution of tones, so that the music could be imitated and learned using LSTM neural network to generate new piano music. According to the test, it is concluded that the music melody and rhythm generated by this method is more stable and meets the demand of the market. Zhang, Y. et al. firstly designed a strategy to extract acoustic features from music melody and synthesized the music melody by using sequence model (Zhang & Li, 2021). Secondly, they constructed a recurrent neural network to synthesize the music melody as a whole, eliminating the need for dynamic features and generating a more complete piano piece. According to the experiments, it is proved that the proposed model is more effective and the generated music is smoother. Huang, C. et al. designed a way to create music by utilizing the energy of musical tension, which can be altered to generate new music, so as to enrich the diversity and innovativeness of the piano music (Huang, 2020). According to the experimental results, the music produced by this approach meets today's market and can attract a large number of listeners. Ferreira, P. et al. used a deep learning model to imitate and learn from the music in order to generate new piano music (Ferreira et al., 2023). According to experiments, the music generated using the model based on the Transformer neural network architecture meets the listeners' expectations, is suitable for the current market, and can be widely promoted. Chen, J. et al. firstly preprocessed the music signals and fed the processed signals into the trained model to obtain the feature maps of the convolutional layers (Chen, 2022). Using the details of the cyberspace and music notation, the feature map of the convolutional layer is constructed to generate new piano music. According to the experimental test, it can be concluded that the music melody generated by the model is more complete, and the song is novel and innovative, which is in line with the current market demand. Lopez-Rincon, O. et al. used genetic algorithms to learn and imitate the music, and used genetic algorithms to generate new piano music as a way of completing the creation of the piano music (Lopez-Rincon et al., 2022). According to the experiments, the music generated by the algorithm meets the aesthetics of the public, and the algorithm is more stable and can be fully promoted.

3. AI PIANO COMPOSITION MODE AND CHARACTERISTICS

3.1 AI Composition Technology Development

Due to the gradual development and maturity of AI technology, the use of AI technology to assist in composing has been widely used. Composition using algorithmic composition or AI technology first occurred in 1957, with the Iliac Suite by Légeron Hiller, followed by the research and development of AI composition by Google and Sony Computer Paris, and then later by virtual artists, AI music gradually showed its prototype. In 2016, AI composition creation was studied and developed by more and more people, and the related theories and knowledge were endless, and in 2019, people's research on AI composition gradually tended to be practical, and gradually came into the life of the public (Amano et al., 2023; Wu et al., 2020). AI composing music has a certain specificity compared with other AI research, and it needs to consider the emotion expressed in the music itself, which is a problem that all art-related AI technology needs to consider. But music is different from sculpture and painting, the existence of music has no form and is an illusory representation. And usually, the representation and the kernel of art are inseparable, and musicians also materialize the consciousness of non-authenticity when they create music, i.e., music is the bearer of ideas. When human beings create music, it is usually divided into three stages: collage, reorganization and cognition, the most basic of which is the collage stage, which is the process of breaking down some finished music and then collaging it. Reorganization, on the other hand, is the process of reassembling the music on the basis of the collage, and finally, the final music is generated according to the form and structure of the music. Therefore, when using AI technology to create music, AI technology is often used to learn and imitate music styles and forms, and then use BP neural networks or self-organizing mapping networks to recombine the music to generate new music. The use of AI technology to create music reduces the cost and time used by composers in creating music, makes the repertoire of the music field more varied and diverse, and advances the field of music and the integration of music and technology.

3.2 Process of AI Composition

The main process of AI composing piano music is to learn different styles of piano repertoire, assist in generating new piano repertoire according to the composer's needs, and complete the creation of piano repertoire. In general, the principles of AI composing piano music are as follows: (1) Deconstruction is to analyze and decompose the piano repertoire. (2) Classification is to keep the style of the piano repertoire. (3) Reconstruction refers to regenerating the piano repertoire.

The above process is similar to the deconstruction, classification and reconstruction of data, which is a kind of data reconstruction. In AI creation of piano music, there is more communication between machines and machines, and the amount of computation is on the high side. So the reconstruction between machines does not only appear in the reconstruction of data, but also in other places, so it is necessary to focus on the interaction ability of the machine, and reasonably utilize it, so as to generate new and different piano repertoire.

3.3 Modes of AI Composition

In the current field of AI composition, there are different ways and modes as follows: (1) In the early AI piano compositions, the music created is mainly in the form of Markov chain approach to convert the relationships in the piano repertoire into probabilities, and set the elements in the music into the corresponding concepts. For example, time value and pitch, etc., and transform them into probabilities on the set concepts, which are used to represent the style of the piano repertoire. In general, Markov chains can be divided into two forms, invisible and explicit, and the essence is mainly to take the current state as a starting point and use the probability matrix of state transfer to transform the next state in the repertoire into a probabilistic problem. Since the Markov chain's only consider the current state form, it is characterized by memorylessness. (2) BP neural networks can generally be divided into supervised and unsupervised, and supervised BP neural networks are mainly used due to the limitations of computer power. There are two structures included in the BP neural network, the input layer and the output layer, the process from the input layer to the output layer can be called as forward conduction. There is a hidden layer between the input and output of the BP neural network, which mainly compares the information, and the information enters the forward conduction from the input layer to the output layer, and after comparing the error between the information and the reference information, the reverse conduction is carried out to the hidden layer, which corrects the weights of the neurons and reduces the error of the information. BP neural networks are characterized by supervision and allow for human intervention. In the field of music, the music chosen affects the machine learning and the aesthetics of the music will also have an effect on the music generated after machine learning. So BP neural network can implement the human learning process in its entirety and eliminate the differences using operations like testing and scoring (Du et al., 2023; Yang, 2020). (3) Today's AI music mainly uses recurrent neural networks and long and short-term memory artificial networks to realize the creation of AI music in a temporal sequence. The recurrent neural network also belongs to a kind of BP neural network, which is a supervised neural network, so there will be human intervention, which can better restore the process of human learning (Li & Lian, 2021; Zhang et al., 2020).

4. AI COMPOSITION FOR PIANO

4.1 Markov Model Creation Model

In the creation of piano compositions using AI techniques, there are many different modes of creation, and the commonly used creation method is the Markov model. Markov model belongs to Markov chain, which is mainly a probabilistic model that uses parameters to describe statistical properties, the state transitions of the model are not observable and the stochastic process of observing the events are unobservable stochastic functions (Amini et al., 2023; Zhang et al., 2024). The components of Markov are as follows:

(1) The set of implied states Q, $Q = \{s_1, s_2, \dots s_N\}$, and $|Q| = N$, while N denotes the number of states of the Markov chain. Denote by q_t the Markov chain at moment t, and $q_t \in Q$. (2) The set of observations $O = \{v_1, v_2, \dots, v_M\}$, and $|O| = M$, M are the number of observations of the implied state in Markov, with o_t representing the observation at moment t, $o_t \in O$. (3) The implied state matrix $A = \{a_{ij}\}$, with a_{ij} representing the probability of states s_i through s_j, in the following equation:

$$a_{ij} = P(q_{t+1} = s_j \mid q_t = s_i), 1 \leq i, j \leq N \quad (1)$$

Eq. $a_{ij} \geq 0, \sum_{j=1}^{N} \quad a_{ij} = 1$.

(4) The matrix of observations is $B = \{b_j(k)\}$, and b_{jk} is used to represent the probability of observation v_k in state s_j in the following equation:

$$b_j(k) = P\{o_t = v_k \mid q_t = s_j\}, 1 \leq j \leq N, 1 \leq k \leq M \quad (2)$$

Eq. $b_j(k) \geq 0, \sum_{k=1}^{M} \quad b_j(k) = 1$.

(5) The initial probability is $\pi = \{\pi_i\}$, and π_i is used to represent the

initial probability of state s_i in the following equation:

$\pi_i = P\{q_1 = s_i\}, 1 \leq i \leq N$ (3)

From this, the Markov model can be represented as a quintuple, specifically $\mu = (N, M, \pi, A, B)$.

4.2 Note Composition

When composing a piano piece using Markov modeling, the notes of the piece need to be described. Where pitch and duration are the basic components of a note, and the tuning in music, the basic tuning and scales are defined by using C_m、D_m、E_m、F_m、G_m、A_m、B_m to represent the seven steps of $m(= \cdots, -2, -1,0,1, \ldots)$ in the tone group, and the value of m to represent the basic scale in the octave range. In the key of C, the seven basic steps are C_0、D_0、E_0、F_0、G_0、A_0、B_0 when $m = 0$ is used, and the pitch position of the basic scale in the pentatonic scale when other values are used.

Variation of the basic pitch level C_m、D_m、E_m、F_m、G_m、A_m、B_m yields ${}^rC_m, {}^rD_m, {}^rE_m, {}^rF_m, {}^rG_m, {}^rA_m, {}^rB_m$, where r represents the lifting and restoring sign.

Let the set of arbitrary levels be $NS^+\{{}^rC_m, {}^rD_m, {}^rE_m, {}^rF_m, {}^rG_m, {}^rA_m, {}^rB_m\}$, where r represents the temporary elevation and reduction, and r can be empty. Let $NS^+ = \cdots \cup NS(-2) \cup NS(-1) \cup NS(0) \cup NS(1) \cup NS(2) \cup \cdots$, it follows that NS^+ represents the set of all tone levels. A description of the duration of a note is represented by the set $DT1 = \{1,2,4,8,16,32,64\}$, where $T(T \in DT1)$ represents the duration of a t -minute note. The notes are represented by PT, where $T \in DT$, P are rests. With AT represents the isochronous and articulated cluster, where $T \in DT$, A are vectors $(a^1, a^2 \ldots, a^L)$ containing $L(L \geq 1)$ elements, where $a^j(1 \leq j \leq L) \in NS$. with $v^1v^2 \ldots v^M$ represents the musical segments in the isochronous and articulated cluster, with $(r/s, VP, T)$ represents the cluster structure, where r/s represents the beats, $VP = (vp^1, \ldots, vp^N)$ represents the vocal segments of the cluster structure, and T represents the total durations. After the notes in a piano piece have been identified, the tuning needs to be converted and adjusted to facilitate the subsequent construction of a new piano piece. In the octave range, the set of pitches is $RP(m) = \{0_m, 1_m, 2_m, 3_m, 4_m, 5_m, 6_m, 7_m, 8_m, 9_m, 10_m, 11_m\}$, where $m = \cdots, -2, -1,0,1,2, \ldots$. The $Scale(K) = \{P^1, \ldots, P^K\}(K \leq 12)$ is used to represent a K -note scale with the dominant of the mode being $P^1 \in Scale(K)$. Typically, modes are divided into two main parts, one being a selection of $K(K \leq 12)$ different pitch levels within an octave to form the modal set $Scale(K) = \{P^1, \ldots, P^K\}$. Secondly, the tonic scale contains the tonic dominant, and the tonic scale is arranged from the dominant from low to high.

In order to be able to enhance the expressive power of piano tunes, it is necessary to perform a level ${}^rR$ transformation of the tuning, $\left(P\ Scale(K)\right)$ belongs to the $K(1 \leq K \leq 12)$-tone tuning, and ${}^rR - TF_k$ is a level ${}^rR$ substitution function of the set $Scale(K)^+$, where R is an integer, and r is the ascending and descending sign. Let $Scale(K) = \{P^1, \ldots, P^K\}, {P^i}_m \in Scale(K)^+, R - TF_k$ be the mapping of set $Scale(K)^+$, that is, the R -level substitution, then the substitution formula is:

$$R - TF_K(P_m^i) = {P^{i+R-nK}}_{m+n} \qquad (4)$$

If $nK + 1 \leq i + R \leq (n+1)K$, where $n = 0,1,2, \ldots$, $m = \cdots -2, -1, 0, 1, 2, \cdots$, get:

$$R - TF_K(P_m^i) = {P^{i+R+(n+1)K}}_{m-n-1} \qquad (5)$$

If $1 - (n+1)K \leq i + R \leq -nK$, where $n = 0,1,2, \ldots$.

Having completed the description of notes and modes according to the above process, the melody and rhythm of the piano need to be analyzed and described in order to make the generated music more beautiful and original. Denote by Ω the collection of pieces of music containing melody M in the form:

$$(M_0 PA_0), (M_1 PA_1), \ldots, (M_i PA_i) \quad (6)$$

$$\left(rhy(M_0) rhy(meta - PA_0)\right), \ldots, \left(rhy(M_T) rhy(meta - PA_T)\right) \quad (7)$$

$$(K - MP(m_0) h_0), \ldots, (K - MP(m_N) h_N) \qquad (8)$$

The above equations are piano music sub-styles, where the rhythm and meter of the piece are in Eq. (7), and there is an imitative structure in $(M_i PA_i)$. A set of training samples $\{\Omega_{xyz}\}$ is built from set Ω and a Markov model of the harmonic part of the music is derived $(H_1, O_1, \pi_1, TP_1, OP_1)$. where H_1 represents the set of implicit states containing the optimal feature chords of training sample $\{\Omega_{xyz}\}$, O_1 represents the set of observations containing the k tonal scale features of the training sample $\{\Omega_{xyz}\}$. TP_1 represents the probability of chord shifts, and a sequence of harmonic motions exists in any kind of musical score $h_0, h_1, \dots, h_n$ and TP_1 is the set representing chord shifts, denoted $\{P(h_{i+1} \mid h_i), i = 0, \dots, T \mid\}$. For any $\Omega \in \{\Omega_{xyz}\}; h_i, h_{i+1} \in H_1$, OP_1 is the set of observation probabilities representing the chord implicit state h_i observed scale feature $K - MP(m_i)$ probabilities, which can be generally denoted as:

$$\{P(k - MP(m_i) \mid h_i), i = 0, \dots T \mid\} \quad (9)$$

Of these, $\Omega \in \{\Omega_{xyz}\}; h_i \in H_1; k - MP(m_i) \in O_1$.

4.3 Practice Flow

The Markov model flow of piano melodic harmony is shown in Fig. 1. After completing the harmonic modeling of the piano, the rhythmic model of the piano piece is specified as $(H_2, O_2, \pi_2, TP_2, OP_2)$. H_2 represents the implied state, which consists of the rhythms $rhy(M_i)$ of the piano piece in set $\{\Omega_{xyz}\}$. O_2 represents the set of observations, which consists of the rhythms $rhy(M_i)$ of the original piano piece in set $\{\Omega_{xyz}\}$, and TP_2 represents the set of rhythmic transfer probabilities, which can be denoted as $TP_2 = \{P(rhy(PA_{i+1}) \mid rhy(PA_i)), i = 0, \dots, T\}$, $\Omega_{xyz} \in \{\Omega_{xyz}\}$. OP_2 represents the set of observation probabilities, which are the probabilities of the rhythms of the melodic fragments $rhy(M_i)$ of the rhythmic implicit states $rhy(PA_i)$ observed in the piano piece.

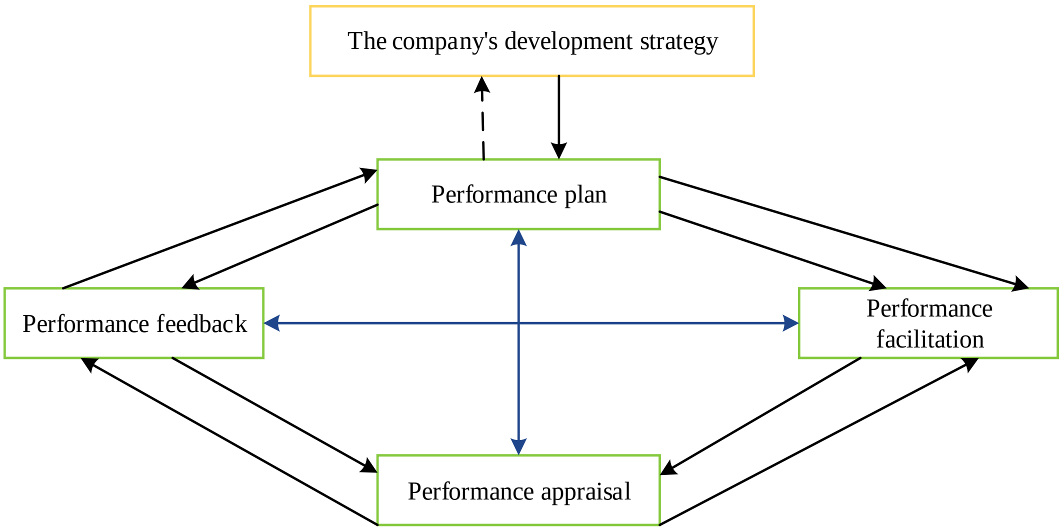

Figure 1: Markov modeling process for piano melodic harmony

The rhythmic Markov modeling process is shown in Fig. 2, where a Markov model is built and the built model is trained as a way to generate new piano music, extracting the information of the piano music that needs to be imitated and learned, including the piano's beat, tempo, and key

(Chen et al., 2021). The piano music is recognized and the form and information of the piano music is imitated.

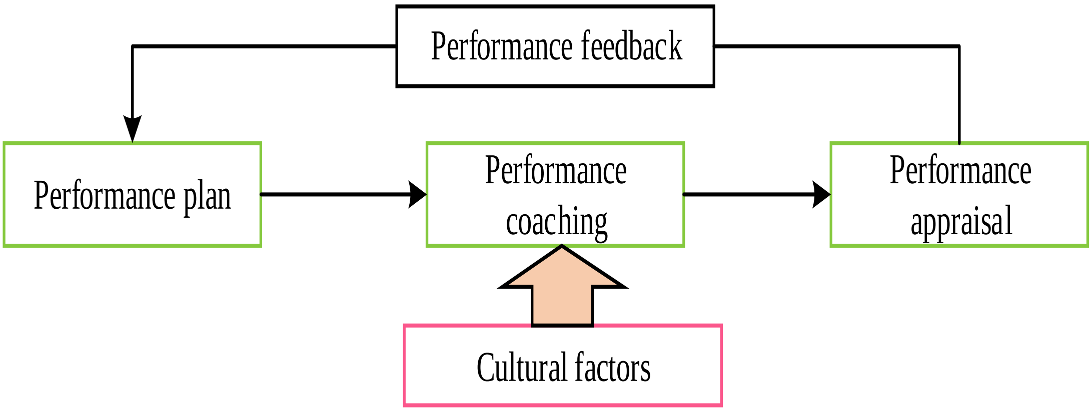

Figure 2: Rhythmic Markov modeling process

Segmenting the imitated piano music information and observing the database in the segmented state, if there is no tone pattern meta-structure in the database, rhythmic observation is performed and the database is updated, by which the rhythmic sequences can be obtained as follows:

$$\left(rhy(M_0)rhy(meta - PA_0)\right), \ldots, \left(rhy(M_T)rhy(meta - PA_T)\right) \quad (10)$$

$$(K - MP(m_0)h_0), \ldots, (K - MP(m_N)h_N) \quad (11)$$

Adjust the tuning of the music from the rhythmic sequences described above to ensure that the generated music is complete. The output of the adjusted piano music completes the creation of AI piano music, and the generated new piano music promotes the development and advancement of the piano music field.

5. AI-ASSISTED PIANO MUSIC COMPOSITION PRACTICE

5.1 Experimental Environment

When analyzing the piano music created by AI, it is necessary to prepare the corresponding experimental equipment and debug the equipment to meet the standards of the test, to ensure that the equipment will not affect the experimental process and results, so that the experimental results are accurate, and Table 1 shows the test server. Evaluate the equipment and software needed for AI music composition technology, so as to ensure the environment and results of the experiment, TensorFlow software is a deep learning framework developed by Google, which mainly utilizes data flow for computation, and is characterized by portability, flexibility and multi-language support.

Table 1: Test servers

Configuration	Element
Central Processor	Inteli7-7800X
Random Access Processor	16GB
Graphics Processor	GeForce RTX 2080

Table 2 shows the experimental software, which can reduce the workload of coding code, improve the efficiency of software development, ease the deployment of CPU, and allow distributed computing due to the richer interface. The React software, on the other hand, is designed by the Facebook team and is mainly used to build JavaScript libraries for user interfaces, making the interactive interface of the software easier and suitable for promotion. If the data changes, the React software can re-update the rendered components and use componentization to make the state and DOM separate, which facilitates the transfer of data, and can better produce the results of the experiment, making the results more convincing and accurate.

Table 2: Experimental software

Functions	Software Name
Deep Learning	Tensor Flow1.12
Feature Extraction	Python3.7
Front-end Frameworks	React16.8.4
Code Editor	Visual Studio Code1.29

5.2 User Satisfaction

User satisfaction analysis is mainly used to measure whether the piano tracks created by AI meet the public's aesthetics and whether the melodies created meet the public's needs. If the user feedback for the piano music created by AI is more positive, it means that the music created by AI meets the user's aesthetics, can meet the user's expectations, and is suitable for today's market. If the feedback of the piano music created by AI is more negative, it means that the piano music created by AI is not in line with the public's aesthetics, is not suitable for today's market, and is difficult to be widely circulated. So 1500 users were surveyed and Table 3 shows the user satisfaction feedback. The piano music created by AI is more in line with the user's needs, for the piano melody created by AI can score 8.5, which indicates that the created melody is more appealing and can be resonated.The piano music created by AI has a better fluency, at 8.3 as, the piano music created by AI has a certain degree of creativity, the style is more novel, and it can reach 7.1 points. This can show that the AI-created piano music program meets the needs of the market and can meet the expectations of users, attracting a large number of users to pay attention to AI-created music, making a positive contribution to the development of AI and promoting the progress of AI music.

Table 3: User Satisfaction Feedback

Assessment Indicators	Specific Description	Assessment Results
Piano Melody	Is the AI created piano melody attention grabbing	8.5
Piano Rhythm	Is the AI-penned piano piece fast-paced?	7.5
Piano Variety	Does the AI compose a piano piece that incorporates a variety of elements?	7
Emotional Resonance	Does the AI piece convey emotion?	8
Harmony	Is the AI's piano piece harmonized and natural?	8.5
Creativity	Is the AI's piano piece innovative?	7.1
Smoothness	Does the AI's piano piece flow smoothly?	8.3

5.3 Music Melody Analysis

The music melody analysis is used to measure whether the melody and rhythm of the piano piece created by AI are stable, and whether the melodic expression is recognizable and resonates with the public. If the musical melody is more expressive and the rhythm is more stable, it means that the piano song generated by AI meets the current aesthetics and is a complete music track that can express the emotion of the music completely. So the generated piano songs need to be analyzed and estimated, and the music melody assessment is shown in Table 4.The piano melody created by AI is better, with high emotional expressiveness and recognizability, in which 86% of the users artificial melody is more fluent, which can be around 8.3 points.

75% of the users think that the rhythm of the melody is better, which can be around 7.5 points, and 87% of the users think that the melody created by AI is more complete, which can be around 7.7 points. It shows that the melody and rhythm of the piano tracks created by AI are more stable, in line with the current market, with a certain degree of recognizability, and can be distinguished from other styles of tracks. And it can express the emotion of the music, show the idea that the music wants to express, and broaden the path of piano repertoire creation.

Table 4: Assessment of Musical Melodies

Assessment Indicators	Specific Description	Assessment Results	Percentage of Ratings
Melodic Innovation	Is the song melody innovative	8	80%
Melodic Aesthetics	Whether the melody of the song is aesthetically pleasing	7	85%
Melodic Rhythm	The rhythm of the melody meets the needs	7.5	75%
Melodic Fluency	Does the melody flow well	8.3	86%
Emotional Expression of the Melody	Does the melody express the emotion of the music	8.7	88%
Melodic Integrity	Is the melody complete	7.7	87%
Melodic Recognition	Is the melody recognizable	7.9	88%

5.4 Musical Similarity Analysis

Music similarity analysis is mainly to compare the similarity between AI generated music and imitated music, if the generated music and imitated music are similar, it means that the AI generated music is less unique and not creative. And if the generated meaning and imitated music are not similar, it means that the AI generated piano music has its own style and melody, Table 5 shows the results of music similarity.The similarity between AI generated music and imitated learned music is low, in the first music clip, the maximum similarity is 20%, the minimum similarity is 2.3%, and the average similarity is 11.2%. While in the third music clip, the maximum similarity was 15.5%, the minimum similarity was 1.3% and the average similarity was 8.4%. In the fifth music clip, the maximum similarity is 13%, the minimum similarity is 1.1%, and the average similarity is 7.1%.The AI-generated music is more unique, with lower similarity to imitation learning, and has a certain degree of creativity and novelty, and the generated piano styles are not just imitation, but have their own melodies, which can promote the development of the AI's music creation and facilitate the music creation Progress.

Table 5 Musical similarity results

Generate Music	Maximum Similarity	Minimum Similarity	Average Similarity
Music Clip 1	20%	2.3%	11.2%
Music Clip 2	16%	1.5%	8.8%
Music Clip 3	15.5%	1.3%	8.4%
Music Clip 4	21%	3.5%	12.3%
Music Clip 5	13%	1.1%	7.1%

5.5 Music Quality Analysis

Music quality analysis is mainly used to measure whether the generated music is coherent and logical or not. If the result of music quality analysis is higher, it means that the generated piano music is of better quality and the piece is more complete and coherent, so the quality of music generated by AI technology, music synthesizer and MIDO technology is analyzed. Table 6 shows the assessment of the quality of music generation, the piano music generated by AI technology is better quality than the music generated by MIDI technology and music synthesizer, the piano music generated by AI technology is more expressive and can be around 7.5 points. While music synthesizer and MIDI technology have 5.5 and 4.5 points of musical expressiveness, AI technology generated music structure is more coherent at around 8.1 points. The structure generated by music synthesizer and MIDI technology is not coherent and lacks logic at around 4 and 4.2 points, which concludes that the piano music generated by AI technology is more effective, with coherent and stable rhythms and logic, which is in line with today's popular music aesthetics.

Table 6: Assessment of the quality of music generation

Assessment Indicators	Specific Description	Music Synthesizer	MIDI Technology	AI Technology
Music Clarity	Whether the generated music is noisy or not	5	5.5	7
Musical Expression	Whether the generated music is emotionally expressive	5.5	4.5	7.5
Musical Structure	Is the structure of the generated music coherent?	4	4.2	8.1
Rhythm	Whether the rhythm of the generated music is stable	5.1	5.3	8

6. CONCLUSION

This paper aims at the development and characteristics of AI composition technology, obtains the process as well as the model of AI technology composition. Secondly, the Markov model is used to compose piano music, which describes the notes and modes in the piano music, and constructs models related to rhythm and melody. Finally, the Markov model was trained to mimic and learn from piano music to generate new music. The generated piano music was tested, and the piano music created by the AI meets the users' expectations, the style of the track is relatively new and innovative, and can reach a score of 7.1, and 75% of the users think that the rhythm of the melody is better, which can be around 7.5. 87% of users think the melody of piano music created by AI is complete and can be around 7.7 points. And the maximum similarity between the generated music and the imitated music is 15.5%, the minimum similarity is 1.3%, and the average similarity is 8.4%, indicating that the AI-generated music has an independent style and characteristics. On the whole, AI-created piano music conforms to users' musical aesthetics, with infectious melodies and rhythms, and is suitable for widespread promotion, which can promote the development of the music field.

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