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Research and realization of new methods for music retrieval

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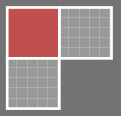
ABSTRACT

For unique feature of music, plus gradually increasing requirements on music retrieval of people, especially under the condition that network music is developing gradually, identification and classification on music have also become ambiguous, while certain difficulty has also been put to copyright protection of songs. In order to guarantee to carry out better retrieval on music, and to achieve higher accuracy of music retrieval, it is required to carry out sufficient recognition on unique features of music, after carrying out sufficient understanding on music retrieval system and retrieval type, based on the original mainstream retrieval system infrastructure, to carry out improvement in the process of flow handling of audio signals, and to develop related new retrieval methods, including extraction of pitch sequence, handling methods for “small pavilion” pitch etc., so as to realize standardized operation of pitch sequence. Meanwhile, another method carrying out marking and ambiguous matching on melody contour is also designed, to define a measuring system related to music retrieval method, so as to complete research and development on music retrieval prototype system. It is obtained via experimental research that, sound matching, better calculating and retrieving methods could be obtained in the new handling flow for retrieval accuracy, so as to improve music retrieval methods in a traditional way.

KEYWORDS

Music retrieval; Retrieval methods; Method research and realization.



INTRODUCTION

For music belongs to a kind of wave, it has physical features like frequency, amplitude and phase etc., as a kind of multimedia audio of great importance, its voice and music is very important for people. Music belongs to a kind of sound composed of human sound and musical instrument sound etc., including fundamental elements like rhythm, melody etc. But for impacts brought by quick growth of digital music and demand for retrieval methods for various music, people always think it is difficult in handling music works, so how to avoid music from being improperly marked and copyright from being infringed, because of intervention of artificial information, it is required to carry out related research on music retrieval.

Emotional and perceptive color of music

When emotions like happiness and anger etc., appear, the composition will accelerate with the intense degree of emotion, thus making lively, allegro etc. marks appear in the composition; when emotions like sadness and sorrow etc. appear, slow and grave etc. marks of the composition will also appear. As for recognition on composition, people are not only limited to physical property of music, but could obtain from people's listening experience, state of mind and environment etc. As for the same composition, if it is played via different musical instruments or at different speeds, feelings generated in people's mind will also be different.

Physical property of music

Musical note is the fundamental unit for music composition, generally, notes include three factors which are namely tone, timbre and loudness. Tone, just as the name implies, has certain internal relations with sound frequency, when frequency rises gradually, tone will also rise with it. For all basic frequencies of music could be obtained via analysis on frequency, so music retrieval could be carried out via utilizing such basic frequencies. For timbre is related to sound waveform, timbres obtained in different musical instruments are also different, this is mainly decided by different waveforms when a sound is made, among which, structure and material of the sounding object itself is the major decisive factor. While loudness is related to amplitude of sound, besides, vibration distance and amplitude of the sound object also impact the loudness directly.

TYPE OF MUSIC RETRIEVAL

Music retrieval based on content

The method of carrying out description on music and carrying out records is mainly synchronized via music score, which carries out accurate description on music notes and standard symbols, to make melody able to obtain a more definite and accurate expression, so as to simplify music scores, and to use simplicity to substitute music score of complexity, as for music retrieval based on content, this is the primary issue to solve. Expression methods for melody contours at present include two types which are namely absolute sound high sequence and relative sound high sequence.

As for absolute sound high sequence, the most important feature of which is the accuracy, while for relative high sound sequence, things are different, relatively speaking, it is to make a fuzzy outline on melody contour. From the middle term of the 1990s of the last century to present, as for music retrieval based on content, quite a lot research has been carried out in research institutes both at home and abroad, and the following music retrieval system based on content as shown in Figure 1 has gradually come into being, via different query methods, library establishing methods, melody expressions, matching modes etc.

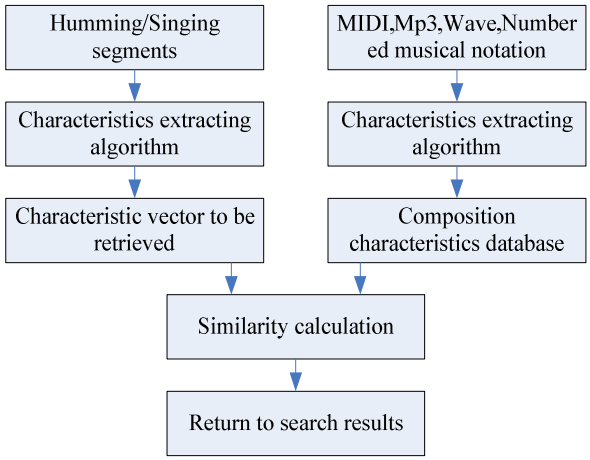


Figure 1 : Music retrieval system based on content

Music retrieval based on text

At present, popular music retrieval methods are similar to those of other normal information retrievals, which are basically retrievals based on text object indexing type, i.e. Baidu etc. which is familiar to us and is widely used. The currently applied text document is to query using keywords, after positioning via using classification method or subject method, so as to retrieve matching resources, and then carry out sorting according to the degree of matching, and provide to users. Although at present music retrieval based on text occupies a mainstream position in the market, for the engine it possesses lacks of corresponding functions to a certain extent, so sometimes results obtained via retrieval are not that clear and detailed.

RESEARCH ON NEW METHODS OF MUSIC RETRIEVAL

Pitch detection and extraction technologies

At present, main technologies used during pitch detection include autocorrelation method in time domain, cepstrum method in frequency domain and wavelet transform analysis method with effective combination of time and frequency, as well as derivative calculation method etc. generated based on this. Although these technologies have obvious advantages and characteristics in certain aspect, during processing, all of them will have a common method, which is to adopt the window framing method for a certain query segment, and carry out pitch extraction on each frame of data after forming multiple frames via carrying out overlapping movement, so as to complete a pitch sequence with representativeness with respect to tone change.

For autocorrelation function could carry out correlation analysis in a short time, so characteristic function will be frequently used during this process, here we define the humming signal to s(m), after it passing a window with a length of N, define the intercepted window framing signal to $S_n(m)$, so as to obtain the defined autocorrelation function of each frame as follows:

$$R_n(k) = \sum_{m=0}^{N-k-1} S(m) S_n(m+k) \quad \textbf{(1)}$$

In formula (1), -N+1<k<N-1. For signal autocorrelation function, on its pitch cycle, especially positions in integral multiple, peak will appear, so we could carry out extraction on pitch cycle value after detecting positions with peak occurred.

After completing pitch extraction, a pitch curve with relatively sound performance could be obtained, as shown in Figure 2. Contour displayed by this curve describes variation generated by pitch occurred in humming segment in a more realistic way. For when human glottis makes a sound, fixed music notes show that the existing waveform could not maintain stability, there're still obvious small amplitude jitters, so in order to implement comparison between real information occurred during singing or humming and variation generated by standard music melody, it is required to adopt post-processing operation on pitch sequence.

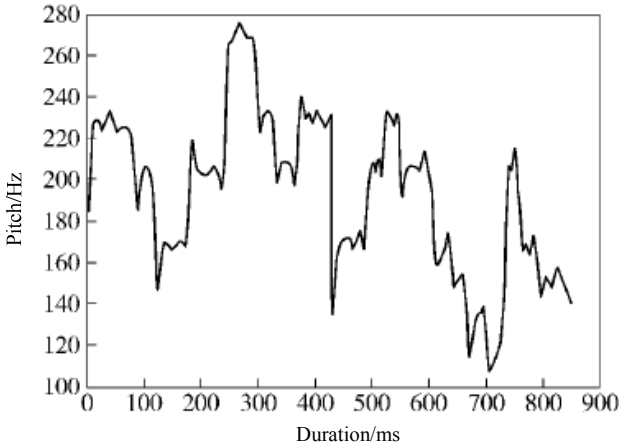


Figure 2 : A pitch curve with relatively sound performance after completing pitch extraction

Small pavilion post-processing method

Except for irregular jitter variation existing in human voice, interferences such as various noises etc. are also inevitable during life collecting process, and this will make estimation values existing in pitch sequences of several pitch cycles stray away from normal track, which are also called wild points, so it is required to carry out smoothing of pitch curve. As for elimination of these wild points, there're multiple smoothing algorithms to be applied, but the relatively frequent ones are mean or median filtering smoothing algorithms during application process. For during humming music retrieval, characteristic sequences to be matched are those obtained via humming as well as those obtained via numbered musical notation. But for certain defects during singing or humming, it is required to enhance musical scale mutation while

eliminating wild points. So, using small pavilion post-processing method we could carry out effective elimination on wild points, meanwhile, we could also maintain stability and jump degeneration possessed by the same musical scale.

SIMILARITY CALCULATING METHOD AND MATCHING METHOD OF MUSIC MELODY

Calculating method of similarity. According to definition, query the possessed characteristic sequence $S=\{s_1,s_2,\ldots\ldots s_n\}$, and its possessed length is m; segment characteristic sequence $T=\{t_1,t_2,\ldots\ldots t_n\}$ generated by each song in music library, and its possessed length is n, at this time the possessed segment length basically corresponds with query characteristic sequence. Provided that similar total score of the song is R, and in actual operation, R=100. Provided that the difference between absolute length of S and T is ΔL, which is also ΔL=|m-n|. Provided that α is the penalty coefficient of length, which means if the difference between T and S is 1 bit, the difference to be generated in similarity degree is α, in actual operation process α=5. Define the distance between $s_i\,(1\le i\le m)$ and $t_j\,(1\le j\le n)$ is D, and $D=\left|s_j-t_j\right|$. Define $\min(S,\ T)$ as the min. difference value calculated via character string S and T according to D, which is the so-called max. similarity degree value, while smaller value indicates better matching between these 2 sequences, and vice versa. The optimal solution could be obtained via the longest common subsequence method possessed by min function in its limited length. So, calculating function of similarity could be:

$$f=R-\alpha\Delta L-\min(s,t) \quad \textbf{(2)}$$

In order to enable sequence length possessed between 2 characters to maintain corresponding, so when ΔL is larger than a certain domain value, the comparison between S and T is not necessary.

MUSIC RETRIEVAL SYSTEM MODEL

Music retrieval system model composition

In order to carry out retrieval on music in a better way, it is required to fully consider issues in all aspects such as relative transform between music information and music score, expression of melody, retrieval of search engine as well as how to make user interface enable users to automatically generate retrieval mode etc. i.e. foreground function design of a music retrieval system with simplicity is as shown in TABLE 1. This design system is to apply controllers similar to piano keyboard, in this way, users could use mouse to carry out easy click input; or use numbered musical notation method via keyboard input, and carry out humming via using a microphone. According to requirements selected by users, corresponding pitch sequence could be achieved, if we only carry out selection on major melody, search could only be carried out in major melody library, otherwise, a whole retrieval will be required.

TABLE 1 : Foreground function design of a music retrieval system with simplicity

Foreground Retrieval Function Design		Description
Musical Instrument Selection		Use musical instrument identification technology, and users could select music to be played by specific musical instruments.
Select Retrieval Method	Exact/Fuzzy	When "Exact" is selected, carry out retrieval on character strings obtained via absolute pitch sequence; when "Fuzzy" is selected, use character strings obtained via using relative pitch sequence to carry out retrieval.
	Whether it is only for major melody	If "Y" is selected, retrieval is only carried out on major melody, otherwise a whole retrieval will be required.
Retrieval Input Method	Simulate piano keyboard Input numbered musical notation Humming (microphone is required)	Obtain an absolute pitch sequence or relative pitch sequence. It is required to consider noise removal while using a microphone.

Performance evaluation on music deceleration system model

In order to verify whether the system could carry out effective retrieval on corresponding songs, and the impact generated by query mode in use, related experiments could be carried out. i.e. if we express the same song via 2 different methods of manual and humming, while the first segment of pitch sequence input manually may be the pitch sequence of climax, the humming mode of "Dadada" will be applied to carry out humming on the song to be queried. Check the result about whether there's any query in the song to be retrieved, if so, which record will contain the output in query result? For

the system outputs according to compact arrangement result of similarity degree, so records in front positions match requirements of results to be queried the most, and results of this experiment are as shown in TABLE 2 and TABLE 3.

Via carrying out observation and research analysis on TABLE 2 and TABLE 3, we could obtain related conclusions on analysis. 1. If songs are different, even if there's considerable similarity in acoustical aspect, but for there's still considerable difference in its pitch sequence, so the difference of it is also very huge. 2. No matter carrying out manual input or humming input, songs to be queried could all be obtained via retrieval on the system, in this way, it could be certified that using this system to carry out query on specific songs and music does have certain capacity. 3. Via comparing manual input with humming method, it could be seen that the accuracy of manual input is higher than that of humming method, however, this requires to possess highly abundant music knowledge, but the practicability is not that large; for humming method, although its application range and scope are both wide, the effect of its query retrieval is not a patch on manual input. 4. Although the ideal query method is the humming method, however, in actual query process, for being impacted by the difference in music accomplishment possessed by the user, when carrying out music and melody query retrieval using the humming method, it is not certain to carry out complete expression and reflection of the song queried, in this way, there must be certain impact on results required by music retrieval query.

TABLE 2 : Retrieval result of manual input method

	Song 1	**Song 2**	**Song 3**	**Song 4**	**Song 5**	**Song 6**	**Song 7**
Retrieval Successful	Y	Y	Y	Y	Y	Y	Y
Retrieval Ranking	1	2	1	1	1	1	1

TABLE 3 : Retrieval result of humming method

	Song 1	**Song 2**	**Song 3**	**Song 4**	**Song 5**	**Song 6**	**Song 7**
Retrieval Successful	Y	Y	Y	Y	Y	Y	Y
Retrieval Ranking	6	3	6	6	5	7	4

CONCLUSIONS

In a word, with fast development of internet as well as popularization of its application, retrieval on music has become a hotspot on internet nowadays, which has gained wide application in people's work, study and life. However, different from traditional literature resources, music resources are relatively miscellaneous, and are hard to communicate, meanwhile, a huge resource also exists, which makes people put forward higher requirements on music retrieval. For research on music retrieval methods is developing constantly, so putting forward and researching new methods on music retrieval have great importance.

REFERENCE

[1] Li Peng, Mingquan Zhou, Xiaoliang Xia, Nanbin Li; Research and realization on new methods for music retrieval [J], Journal of Beijing University of Posts and Telecommunications, **(06)**, **(2010)**.

[2] Sun Xu, Jihong Guan; Waveform music retrieval regarding spectrogram similarity as its measurement[J], Computer Engineering and Application, **(05)**, **(2009)**.

[3] Ju Yuan; Research and exploration on music retrieval system based on humming[J], Journal of Information, **(06)**, **(2010)**.

[4] Haodong Zhou, Liu Wei; Music retrieval based on latent semantic analysis[J], Computer Engineering and Design, **(06)**, **(2013)**.

[5] Lijuan Zhou, Hongfei Lin, Yan Jun; Music information retrieval model based on TLDA and SVSM[J], Computer Science, **(02)**, **(2014)**.

[6] Xirong Ma, Jinglian Liang; Music retrieval system research based on emotional music module[J], Computer Science, **(01)**, **(2009)**.

[7] Xiang Yi, Yubin Zhong; Research and realization on music humming retrieval based on fuzzy clustering[J], Journal of Jiangnan University (Natural Science Edition), **(06)**, **(2012)**.

[8] Fu Li, Sun Jian, Chunlei Fu; Music retrieval system based on semanteme[J], Journal of Chongqing University of Technology (Natural Science Edition), **(01)**, **(2011)**.

[9] Liu Ming, Hongli Liu; Comparative research on music retrieval methods based on content[J], Shanxi Science & Technology, **(07)**, **(2012)**.

[10] Youping Gao, Mingwen Tong, Zhang Kai, Juping Ye, Linlin Chen; Music emotional retrieval technology based on fuzzy mathematics[J], Computer Science, **(06)**, **(2013)**.