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Research on Music Information Visualization of Chime Bells of Marquis Yi of Zeng

Caixi Yang[1,*]

[1]*South-Central Minzu University, Wuhan, China*
[*]*Corresponding author: 707467199@qq.com*

Abstract: *Chime bells of Marquis Yi of Zeng is an important ritual and musical instrument in ancient China, which embodies great cultural value and social influence. However, the particularity of the chime itself is not convenient to go out for display. The audience can only watch the chime through the protective glass, so they can't directly enjoy the unique music of the chime. This paper will introduce the music information of chime, think about the problems faced by chime music display at this stage, analyze the implementation method of sound visualization, explore the feasibility of chime music visualization, and explore the method of chime music visualization.*

Keywords: *Chime bells of Marquis Yi of Zeng, Music visualization, Cultural value*

1. Overview of Chime Bells of Marquis Yi of Zeng

The chime bells of Marquis Yi of Zeng were a musical instrument in the early Warring States period, representing the highest achievement of the "etiquette and music civilization" in the pre-Qin period of China. It is often played at the birthday of the emperor, the sacrifice of ancestors, the triumphant return of officers and soldiers, and the "national funeral". Because it was unearthed in the tomb of marquis Zeng Yi, archaeologists call it the "chime bell of marquis Zeng Yi", which is the largest and most complete set of chimes unearthed in China. It has important research value in phonological research, technological manufacturing, cultural Archaeology, and other aspects. It is an object of wide concern in the academic community and an important theme for the education and dissemination of ancient culture.

1.1 Musical Features of Chime Bells

Chimes, made of bronze, are important bell percussion instruments in ancient China. A set of 65 pieces is divided into three groups: the Bass Yong bells, the alto Yong bells, and the Niu bells. [1]

(1) The width of the range of music: the tuning method of chime bells is to leave traces of grinding in the interior during manufacturing. The thickness of the wall of the bell is related to the frequency of the speech, the thickness of the wall is higher, and vice versa. Chime bells have 8 bells in each group, which is divided into 8 groups in total. The 65 bells are arranged from bass to treble according to the size of the bell body, spanning five octaves and producing 128 tones. [2] This wide range allows Chime to be flexible when playing various tunes.

(2) In ancient China, the rhythm of the Han nationality was usually composed of five rhythms of "Gong, Shang, Jiao, Hui, and Yu". The chime of Marquis Yi of Zeng was divided into three regions from top to bottom: high, medium, and low. The middle midrange was the core region. In this region, it was found that it had a complete twelve semitones within the octave, and the rhythm was the same as the modern international twelve average scale. [2]

(3) The pronunciation and timbre characteristics of the bell body: "one bell and two tones" is the characteristic of the chime bells of marquis Yi of Zeng. The two tones of the third degree do not interfere with each other, but can also be struck at the same time to produce harmony. When hitting the front and side of each bell body, different pitches of the third or minor third will be played, which are also called "positive drum tone" and "side drum tone" very regularly.

Chime bells are large, so it takes a lot of people to play them. The instrument of performance is the T-shaped mallet. The main performance skills of chime bells are as follows: percussion, smudging, shaking, stroke and rolling.

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Beating chimes at different positions can be played with different range widths, and the generated sound can resonate and control the overtone. The chiming bell can emit 128 tones, with a very wide range of tones, in addition to the zodiac clock sent by the king of Chu. The accuracy of the chime's rhythm is also proved in "one bell with two tones". The chime's tone is loud and deep in the bass, mellow and beautiful in the Alto, and clear and bright in the treble button. The value of chimes symbolizes the 5000-year civilization of the Chinese nation and is a cultural treasure of China.

1.2 Research Status of Chime Bells

There are many journals and magazines about chime-bells in China. The early research mainly discussed in detail the humanistic value, musical characteristics, scientific and technological value, historical value, and other aspects of the chime bells of Marquis Yi of Zeng. Among them, Zichu Wang has the most studies on chime bells of Marquis Yi of Zeng, involving the analysis of melody, restoration techniques, history, and culture.

There is also some research on the modern design and application of chime bells. Weiqi Xiong studies the optimization and realization of interactive virtual reality technology on the dissemination function of museum cultural relic information. Xiao Yang combined games with science popularization to create the chimes music simulation game of Marquis Yi of Zeng. Qiujie Jiang conducted research on Chime Bells digitization based on natural interaction in 2020. Xia Bei, Yao Leyte, and others have applied The marquis Yi of Zeng's chime pattern in the field of cultural and creative design and fashion design.The 7th CISM Military World Games in 2019 were held in Wuhan. The digital experience of the chime bells of Marquis Yi of Zeng surprised domestic and foreign audiences. VR naked eye 3D can make the audience feel the fun of striking the chime.

To sum up, the number of chime design practices is still relatively small, and the research on visual analysis of chime music has not yet appeared. Therefore, the research on the music visualization of the chime bells of Marquis Yi of Zeng has great research value both in theoretical research and practical application.

1.3 Reflections on the Development of Chimes

Because of the special way of preservation, the chime bells are not convenient to be exposed to and exhibited. They are only for distant viewing and learning. Therefore, the digital display and application of chime bells is a great choice, but there are still many limitations in digital practice:

First, most digital applications at present are just a display of chime bells themselves. At present, the chime bells of Marquis Yi of Zeng interactive system only realize two directions of display: one is the static display of images, text, and sound, and the other is the pure interactive device implanted by technology [3]. Such as wearing VR glasses to simulate chime bells and other technology implanted interactive devices. It is still difficult for users to accept chime bell information due to limited means of display and high professional requirements for controller operation.

The second is to ignore the uniqueness of chime music itself. In addition to the exquisite manufacturing process, chime bells also have wonderful unique musical attributes, which need to be further explored. In the information age, sound visualization can transform abstract music data into visual elements that are easy for users to understand. As a way of digital display, music visualization can help users obtain chime bells information more intuitively and conveniently and convey the characteristics of chime bells.

2. Digital Music Visualization Art

2.1 Concept of Music Visualization

Music visualization is to present the state of sound in the form of vision. One of the purposes of music visualization is to enhance the readability of music information and facilitate the interpretation of more complex and scattered music information sets. Because music works can convey emotions, their visual works will also show emotional characteristics that are consistent with the music itself, making artistic emotions and ideas more three-dimensional and easier to cause emotional resonance.

Music visualization is also divided into music information visualization and music emotion visualization. Music information visualization focuses on describing the physical characteristics of music, such as pitch, length, and rhythm, and presents the relationship between hearing and vision on the physical

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level visually[4]; Music emotion visualization refers to the audio-visual "synesthesia" at the psychological level.[4]

2.2 Implementation Way of Music Visualization

The mapping mode between sound and visual representation provides a theoretical basis for the design of sound visualization, which needs to be realized by certain technologies or methods under specific mapping modes so that sound can be visually presented according to mapping rules [5]. At present, there are two kinds of realization paths, namely physical realization, and digital realization.

Physical realization is aimed at physical sound mapping, using the sound resonance principle to express sound vibration with visual material. Through the use of physical principles and science and technology, the audience can feel scientific and interested while participating in the realization of visualization, which enhances the appeal to the audience. The designer GGGFW designed a set of experimental devices connected with the electronic organ by using the principle of the Chladni plate experiment. The corresponding visual graphics were triggered by the sound of the electronic organ, and then the graphics presented by different notes were symbolized.

Digital implementation methods appear with the development of electronic media. Generally speaking, from the perspective of the mapping and transformation of sound and vision, the realization of sound to visual performance requires technical processing in sound sampling, sound noise reduction, touch sensing, sound analysis, and feature extraction, sound visual programming, multimedia presentation[5], and other aspects, to achieve an interactive sound visual effect.

2.3 The Rationality of Chime Music Visualization

The chime bells of Marquis Yi of Zeng have many achievements in theoretical research and design practice, which lays a foundation for the visualization of chime music. Therefore, the visual design of chime music, first, can enrich the transmission mode of chime music, second, visualization technology can bring a stronger sense of experience to the audience, and third, it explores more possibilities in the field of creation and appreciation of chimes. Audio-visual interaction is the future trend, and music is constantly breaking the limitations of auditory art. Audio-visual interaction is the trend of the future. Music is constantly breaking the limitations of audio-visual art. The use of certain laws of artistic composition to pure visual symbols can convey the aesthetic feeling of music; The visual image can be transmitted by arranging the aural symbols such as intervals and melodies according to certain rules.

3. The Path of Digital Music Visualization in the Inheritance and Development of Chimes

To enhance users' interest and sense of experience, from the visual dimension and immersion, sound visualization can use a two-dimensional plane or three-dimensional expression forms and combine digital technology to create a highly immersive visual expression effect. Various visual forms can improve the interactive experience effect of user participation behavior, and provide more possibilities of visual expression forms for the sound visualization of chimes.

3.1 Multi-dimensional Visual Applications

According to the visualization of sound, music visualization can be divided into two-dimensional visualization and three-dimensional visualization.

(1) A two-dimensional plane is an image. Two dimensions exist only in two physical units, length, and width. Two-dimensional plane image has become the most widely used visual representation form in sound visualization because of its susceptibility, ease of transmission, and operability [5]. Early artists expressed their feelings about music through paintings, such as Mondrian's "Jazz on Broadway" and Kandinsky's works, which achieved harmony in the form of music in the visual form in paintings, which was a kind of inner spiritual harmony. With the development of the information age, music visualization is also presented by digital means, and the picture also moves from static to dynamic. Such as Poland according to classic music more visual story of animation short films "classical music animation set, animation to interpret music and make full content, beyond the simple music drama and significance of animation, music, and picture extremely harmonious, including many songs such as" Carmen "presented to the public on the form of animation.

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(2) Three-dimensional stereo image. The three-dimensional form of expression is used to perform interactive sound visualization. Three-dimensional objects of large-scale multimedia devices are usually used to achieve three-dimensional effects. Three-dimensional visual expression space has depth and three-dimensional sense, which can not only be seen and touched by the naked eye but also exist in the expression space and environment, producing a strong sense of reality and a sense of the scene.

The online display of the Hubei Provincial Museum uses 3D technology to dis-play the chiming clock. You can see the complete display environment on your mobile phone. Every cultural relic in the exhibition hall can be viewed slowly. Visitors can also choose their visiting direction and staying time according to the system prompts. When the "footsteps" of the visitors stop in front of the chiming clock, a beating button appears on the screen. Click in to see the text of the chiming clock, with pictures and texts, to avoid cursory observation. In addition, the VR holographic projection of the military games mentioned above simulates the beating of chimes and immersively experiences the beating of chimes. This is also the way of using multi-dimensional images to inherit culture in the inheritance and development of chime bells of Marquis Yi of Zeng culture.

With the development of cultural diversity, compared with the untouchable cultural relics viewed through the glass in the museum, many people are looking forward to the chiming clock being promoted to the public in a "friendly" way. For example, the famous music score of the chime bells is visually analyzed, and the music propaganda animation reflecting the cultural characteristics of the chime bells is launched. "Artistic conception" is an important direction to infect the audience's emotions in music visualization. Therefore, in addition to using virtual image technology to experience the realistic experience effect, the digital display of the chiming music can also extract and design the chiming music, so that the audience can see the music they "created".

3.2 The Application of Immersive Interactive Environments

The human-computer interaction technology provides technical support for the application of digital music visualization image interactive devices. To create interactive virtual environments, people need to interact with visual systems[5]. When people find that they are participants in visual effects while making sound, it will arouse people's interest, improve intrinsic motivation, and achieve immersive interaction effects. This visual representation is an open design scene, which is not completely set by the designer, and the audience not only customizes the sound but is also a participant in the final visual representation.

As one of the treasures of the town museum in Hubei Province, the museum must popularize chime bells to the public. The museum can use digital sound visualization technology. For example, the chime bells of Marquis Yi of Zeng can be used in participatory visual scenes. Those chime bells are divided into three groups: the Bass chimes, the Alto chimes, and the Niu chimes. Each chime is equipped with a computer-controlled mallet. Through the movement of the visitors' bodies, the live chimes begin to play. Visitors can move their bodies on the wall equipped with sensors to beat their beats. At the same time, different light colors and patterns will be displayed around the chimes according to different beats. This visual interpretation of music integrates hearing and vision, combines traditional culture with modern technology, and brings the shelved chime bells into people's lives in an interesting interactive way, which is conducive to the inheritance and dissemination of chime bells culture.

4. Conclusion

As an important cultural relic in China and even the world, the chime bells of marquis Yi of Zeng has unique artistic value and cultural connotation. This study proposes to present the music information of chime visually so that users can feel a more efficient, intuitive, and interesting experience when experiencing chime music. The cultural characteristics of chime bells have also been displayed and spread to a greater extent through this method.

The cultural heritage of chime bells is extensive and profound, and the author's research is far from enough. The visualization method proposed in this paper has many deficiencies. I hope that the author's research can arouse more people's attention to the display and dissemination of chime music, excavate its internal charm from more angles, and explore more design methods. At the same time, I hope this paper can provide some ideas for other cultural relics of Music Visualization Research in the future.

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